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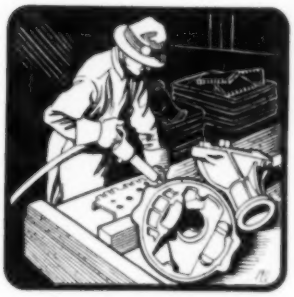

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THE FOUNDRY is published monthly on the 15th of each month by the Penton Publishing Co., Penton building, 1213 W. Third St., Cleveland, O. JOHN A. PENTON, Chairman, Board of Directors; C. J. STARK, President; J. D. PEASE, Vice President; F. V. COLE, Secretary. Member, Audit Bureau of Circulations, Associated Business Papers and National Publishers Association.

Branch Offices: Chicago, Peoples Gas building; New York,, 220 Broadway; Pittsburgh, Oliver building; Washington, National Press building; London, Caxton House, Westminster, S.W. 1; Birmingham, England, 14 New street; Paris, 9 Rue de Londres; Berlin, Lichterfeld-West, Dahlmerstrasse, 64a, Germany. Cable address, Irotrapen, London.

Subscription: United States and Mexico, $2.00 a year; Canada, $3.00 a year; Great Britain and other Foreign Countries, $4.00 a year; single copies 25 cents. Copies published three months or more previous to date of current issue, 50 cents each. Entered as second class matter at post office at Cleveland under the Act of March 3, 1879. Copyright 1933 by the Penton Publishing Co.

ADVERTISING PAGES REMOVED

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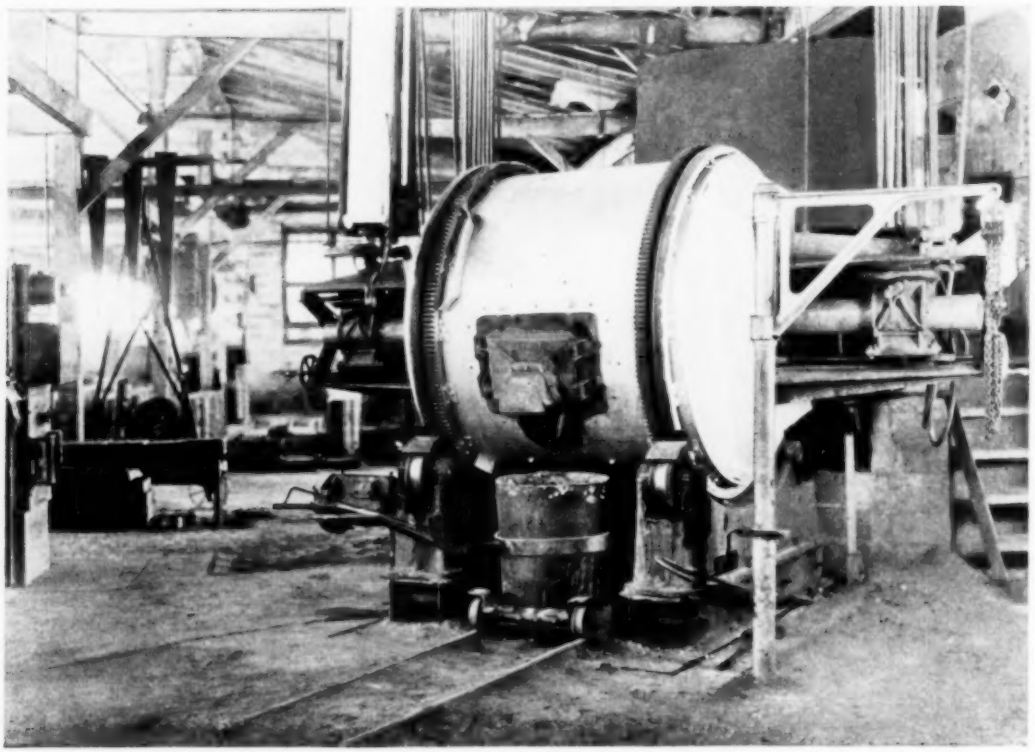

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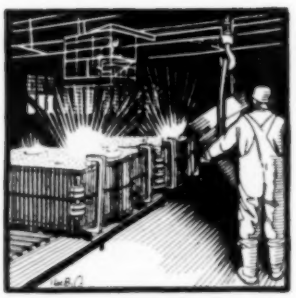


THE FOUNDRY for March

Foundries TIGHTEN BELTS

ALTHOUGH this is written at the time when banks and all financial institutions are closed by Presidential decree, despair is not reflected in a quick canvass of foundry opinion. The immediate problem of assembling payroll funds is paramount. Several, in the face of prevalent uncertainty are manfully maintaining operations on work at hand. All expect relief to develop quickly from the very nature of the crisis. Larger plants are well stocked with materials, despite the downward trend in inventories. Low prices have led the big users of nonferrous metals to stock ahead for many months requirements. Many expect the removal of the banking jam to bring higher prices, whether through stimulation of demand or through inflation which is taking place. The foundry industry will move forward from the week of March 6.

As Always VIRTUE PAYS

THE second and concluding article on good housekeeping practices at the Falk company affirms a truth. A clean, orderly foundry *pays* in reduced operating costs, in prevention of waste, in greater production and in improvement of morale and health standards. The management is thoroughly convinced of the economic value of the clean-up campaign that it has carried through to such effective conclusion. Alleviation of the dust hazard is not the least important of the accomplishments of this program which has been introduced in many of the leading foundries. Danger from this source which has been discussed and emphasized over the past several years and with increasing intensity more recently, may be avoided. Foundrymen have every consideration for the health and comfort of their men. Their care in this particular can be made most effective in a clean shop, free from accumulations of dust and debris.

Have Hand in NEW DEAL

NO ONE acquainted with the fast moving events of 1933 can overlook the fact that a change is taking place. During the period of stagnation which has engulfed all business, the foundry industry has not been futilely idle. In every major branch, technical developments have advanced at a rapid place. Regardless of what character of casting may be sought by the consuming public, the foundry industry can furnish a better product now than in 1929. Uses have broadened in proportion. The adaption of castings to purposes previously unknown has created new fields. The grim requirements of the times have introduced better methods and improved technique. At the same time, a chastening realization of the interdependence of all upon the common welfare has brought a more sane and cooperative spirit between competitors in the foundry industry. The new deal has brought a pat hand to foundrymen.

What's New in MARCH

OXYGEN, life giving in steel refinement, becomes a blemish if retained (page 13). Progress paraded, information infused, contacts consolidated, lessons learned, self-interest served and advancement assured at Chicago in June (page 15). Heat treatment, the cheapest way to make a good product better, as applied to gray iron (page 19). Cupola malleable seldom explained is detailed (page 24).

Temperature Affects Molding Sand

Various factors influence behavior of the sand constituents when the mold is poured

By SIXTEN O. V. NILSSON

Swedish Manufacturers Association

FROM existing foundry literature it seems that the behavior of molding sand during the journey of the casting has not been the subject of such an interest as is deserving. The prevailing idea seems to be that sand grains at a certain temperature begin to sinter and at an increased temperature they melt together more or less. Sintering of sand is supposed to be the cause of the *burning on* of the molding sand and for that reason the sintering point usually is tested. However, *Standards and Tentative Standards* of the A. F. A. do not suggest or propose testing molding sand to determine the behavior when heated to casting temperature, although properties of sand at lower temperatures have not been taken into consideration. Nevertheless judging from the authors practical experiences and investigations, behavior at casting temperatures plays a more important role than the position of the sintering point.

Connected With Changes in Volume

It is well known that the main constituents of molding sand are silica grains and clay. Silica exists in several modifications with different properties. Some modifications are developed by heating silica to certain temperatures. Some are stable when returning to usual temperature and others are stable only within certain limited temperature ranges. Some transformations occur suddenly as soon as a certain temperature is reached, while others proceed slowly or with great inertia. Almost without exception these transformations are connected with changes in volume more or less.

The most usual form of silica in nature, namely quartz, has a specific gravity of about 265, while those modifications which are developed by heating have a lower specific gravity, down to 221. It is evident that molding sand, being subjected to a strong heat for the first time, must show a tendency to expand or swell and that such an expansion also can be expected by following reheating, because some of the modification-alterations are reversible.

Strongest expansion ordinary takes place at the first heating to temperatures over 2372 degrees Fahr. and depends upon quartz transforming into tridymite which is followed by an increase in the volume of 15.3 per cent. Even at lower temperatures similar transformations occur, the most important being the α-quartz transforming into β-quartz at 1067 degrees Fahr. At this temperature a sudden inversion in the

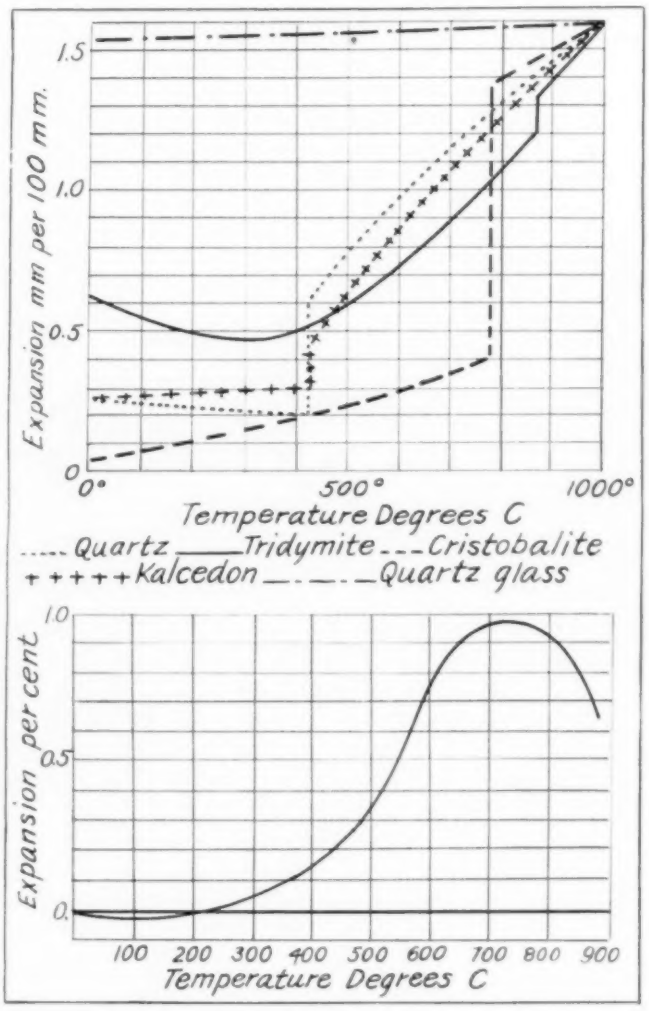


Fig. 1—Expansion curves of silica minerals heated from 0 to 1000 degrees Cent. Fig. 2—Average dilatation curve of molding sand

atomic crystal structure occurs. Expansion is not great, only 0.4 per cent, but the rapid manner in which it takes place causes a splintering of quartz grains and, when sand is used as molding sand, a roughening of the mold surface.

Fig. 1 shows the thermal dilatation of different silica modifications according to H. Le Chatelier. These properties are well known by the manufacturers of refractory materials, but they do not seem to have been taken into consideration by foundrymen. However, as will be shown, they explain in a natural way several difficulties encountered in manufacturing castings.

Cannot Return to Plastic State

The bonding material or clay, which is found in molding sand or is worked in by making synthetic molding sand, consists mostly of fine mineral constituents. Typical clays contain considerable quantities of particles of fineness corresponding to the colloids which have dimensions from 0.0001 to 0.000001 millimeters. Some of the clays contain considerable quantities of basic constituents: Al_2O_3, Fe_2O_3, MgO, CaO and alkalies and frequently also $CaCO_3$. The purest clay, kaolin, has the composition $Al_2O_3 \cdot 2\ SiO_2 \cdot 2\ H_2O$. By heating the clay to 230 degrees Fahr. it loses all the water, which is kept in the pores or is adsorbed on the surface of the clay particles. At higher temperatures the water chemically combined with mineral constituents as the hydrates of iron oxide, aluminum oxide and silica found in hydrosilicate form, is driven out. In fireclays, kaolin is the main hydrosilicate and contains 13.9 per cent water. By heating to 840 to 932 degrees Fahr. it loses half of that water content and by heating for 1 hour to 1112 degrees Fahr. all chemically combined water is driven out. In such a case the clay cannot be made plastic and binding again. These circumstances also have a bearing upon the behavior of molding sand when heated.

Fig. 3—A test piece showing a heavily burnt on condition. X4, etched

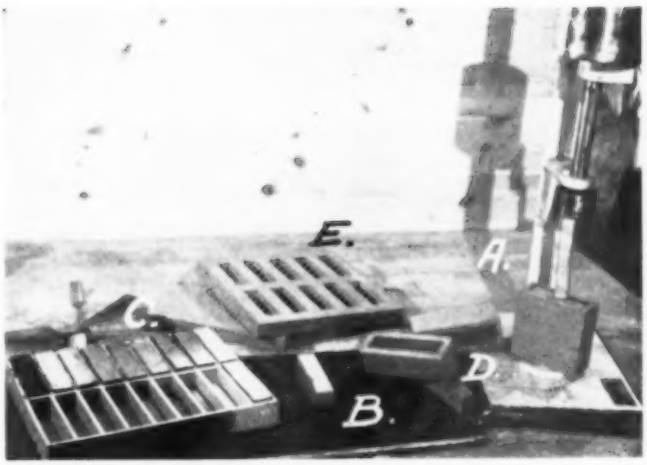


Fig. 4—Small prismatic test pieces were made in a corebox for the burning on test

That part of the molding material, which forms the mold surface, frequently is heated strongly during the time the mold is being filled with metal. Heat radiation from the melted mass may, especially on big castings, be so intense, that the temperature at which the quartz transforms from α- to β- quartz is reached. From the previous discussion it is evident that clay loses its binding property at that temperature. Thus the sand grains in the mold surface expand and move in relation to each other and the binding material loses its bond. Thus in practice a surface layer, which is heated strongly through radiation, works loose from the mold-wall and falls down in the metal. Sand particles thus are carried to other parts of the mold where they remain on the surface or are surrounded by metal and cause rejection of the casting. Where the sand surface has been loosened, the castings are rough and are referred to as *scabbed castings*.

Castings Show Deep Grooves

Not always is there sufficient time for the phenomenon to develop completely. Sometimes the castings only show more or less deep grooves, which indicate that the surface has expanded, burst and bulged out. The author is inclined to believe that *rat-tails*, a phenomenon well known to stoveplate makers, results from expansion and bulging up of the mold-surface along the metal stream. As will be shown later, another explanation also can be derived from investigations on the properties of molding sand by heating.

It is a well-known fact that various molding sands act differently as the *scabbing* phenomenon. This can be explained from the mineral composition and from the properties of the clay.

In addition, such facts as the pouring temperature, pouring time, casting thickness, ramming degree and the form of the mold surface, influence the phenomenon. Low pouring temperature, short pouring time, eight casting thickness, soft ramming of the mold and a concave surface of the mold help to avoid the scabbing.

The previous explanations give a basis for the statement that each molding sand demands the completion of the pouring within a certain time. Pouring must be completed before any part of the mold surface is heated to the critical temperature, when the sand grains expand or the clay loses its bond.

Make Two Tests on Sand

It also is evident that the scabbing phenomenon can be checked or modified by mixing the molding sand with materials which shrink when heated, or burn away. Mixing with coal dust is common. Sometimes sawdust and moss-litter are used, specially in making dry sand molds.

One can get an idea of how the molding sand will stand against the pouring heat by making two different tests. One is carried out as a dilatation test. A small sand cylinder, (1). Fig. 6, which is ½-inch diameter and 2 inches long, is rammed and put in an iron pipe (2) with slightly larger inside diameter. One end of the pipe is provided with a bottom (3) which is welded to the pipe. The sand cylinder is placed on the bottom carefully and a small plate (4) of quartz glass is placed on the top of the cylinder. The pipe is introduced in a suitable electric furnace (5) and is fastened to a stand (6). A quartz glass pipe (7) is placed on top of the sand cylinder, and can slide in the holder (8). Finally some arrangement is provided for the determination of the movement of the glass pipe, for example a dial gage (9). The temperature inside the iron pipe is controlled by a thermoelectric pyrometer (10). Expansion of the iron pipe is ascertained by a preparatory test. As will be understood from Fig. 1. the expansion of the quartz glass pipe may be neglected. By raising the temperature slowly it now is possible to notice changes in the length of the sand cylinder. The author has found through investigations that the cylinders of different sands begin to expand slowly at about from 392 to 572 degrees Fahr. Sometimes a slight contraction will be noted at first when tests are made with green sand. The expansion increases and is specially large from 932 to 1112 degrees Fahr. The cylinder reaches its greatest length at about 1292 or 1472 degrees. Thereafter it sinks slowly. The average progress of the test graphically is shown in Fig. 2. Different sands show different curves and higher ramming degree raises the curve. In the author's investigation the average expansion at the top of the curve was about 1 per cent.

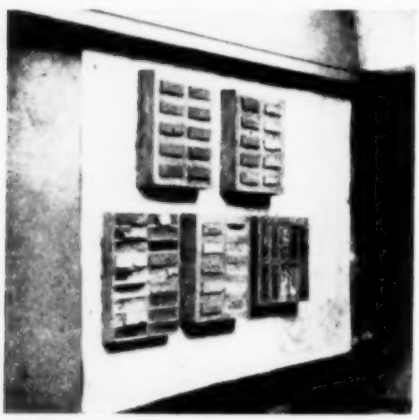


Fig. 5—Pieces were allowed to cool in the mold and shaken out with care

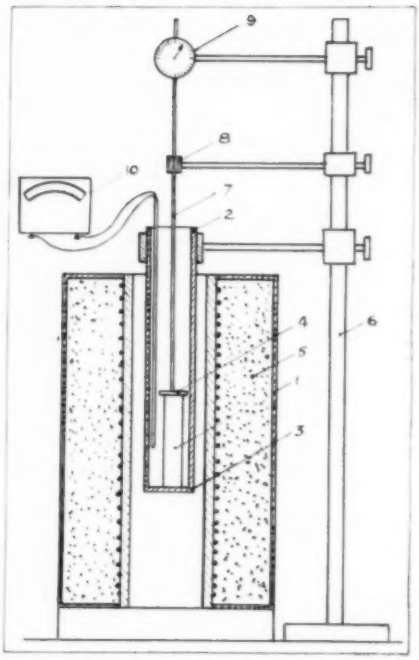


Fig. 6—Sketch showing the principal parts of the dilatometer

The same electric furnace may be used in the second test. It must be in the horizontal position and arranged with a refractory pipe as is usual in the direct-combustion method for determining carbon in iron. Sand in the dry state is packed loosely in the small porcelain boats or containers which are used in the test. The surface is struck off evenly and the boat is introduced in the pipe of the furnace, already heated to proper temperature, for instance 2462 degrees Fahr. as the average pouring temperature for cast iron. The sand surface is observed carefully all the time and the observations refer to the following:

Decrepitation means the phenomenon which consists in some grains being shot in the air with a crackling sound. Decrepitation takes place at lower temperatures, probably within the temperature range up to 1112 degrees Fahr, and surely depends upon the previously mentioned transformation in quartz. Presence of small grains of lime also may result similarly.

Gas eruptions sometimes are noticed in fine grained sands such as are used in stoveplate foundries. Small craters appear on the surface of the sand from which fine dust particles are thrown up. These eruptions may be caused by lime particles, which are split up in $CaO + CO_2$, the latter being the escaping gas. They also may be caused by evaporation of hydrated water, the vapor carrying away small sand and clay particles.

Expansion in the sand results in a projection of the sand surface beyond the border of the container or a rising of (*Please turn to page* 44)

Oxygen in Acid Electric Steel

Fluidity in steel is related to presence of dissolved oxide or suboxide of iron

By HENRY D. PHILLIPS

Metallurgist, West Lawn, Pa.

DESPITE the fact that the entire steel industry depends upon the control of oxygen content during the refining process, comparatively little is known of the effect of that element upon steel, particularly the influence of minute amounts of oxygen dissolved in the metal. Nearly every obscure ailment of steel has, in the absence of evidence to the contrary, been ascribed to the effect of some gaseous element such as oxygen, hydrogen or nitrogen. In this discussion of the subject, while absolute proof of oxygen's effect upon the phenomena noted is not available, substantial evidence is present in the form of results obtained.

During the working of an acid electric heat the steel contains iron oxide which must be eliminated, the quality of the steel depending upon the extent to which it is done. If not enough is removed "wild" steel results and if too much is removed other undesirable results may become evident.

Depends on Iron Oxide Present

It generally is believed that inclusions are responsible for a great many failures of steel in service. Iron oxide is the basis of most inclusions and the type found in the steel depends upon the amount of iron oxide present when they were formed and the type of deoxidizer used.

Most every steel foundryman has associated *wildness* in steel with insufficient deoxidation, but while they nearly all have noted a lack of fluidity and other abnormal behavior of some acid electric steels, few, if any, have associated it with a lack of iron oxide in the steel, or too much deoxidation.

Batty seems to have been the first to note and record the influence of small amounts of iron oxide upon the fluidity of steel. In a paper presented before the Sheffield Society of Metallurgists and Metallurgical Chemists in October 1923, he discussed the subject, noting that fluidity is not a direct function of temperature and conventional composition alone, but that it is affected by an element not ordinarily determined in steel analysis, namely, oxygen, as iron oxide or a presumed suboxide of iron.

He concluded from his observations that fluidity, or fluid life in a steel is related to the presence of dissolved oxide or suboxide of iron and that a steel containing little or none of that dissolved oxide evolves a great deal of its surface heat as light, and hence loses its fluidity. He found that these steels are lighter in the liquid condition and have a higher freezing point than steel otherwise similar in composition but containing normal amounts of dissolved oxide.

Obtained at Expense of Temperature

A steel lacking in this iron oxide would then be expected to have a higher fluid and solid contraction than an otherwise *normal* steel. This is so, and such steels cause more rejections than normal steel due to pipe cavities, hot cracks, etc. In the absence of this iron oxide the requisite fluidity must be obtained at the expense of temperature, with a resultant increase in fuel consumption, refractory wear and mold attack.

Therefore, this controlled presence of dissolved oxide of iron in steel for castings results in increased productivity from metal in the ladle due to the almost entire absence of metal freezing in the nozzle, or in hand-shanks, and the reduced size of risers which may be employed. It results in fewer rejections due to the slightly lower solid contraction, the ability to produce thinner sections and the better surface resultant upon the decreased surface tension of the more fluid steel contacting with the mold during casting. Freer machining properties also may be noticed and of particular importance to the furnace operator is the decreased wear on refractories and reduced current consumption because the requisite fluidity is attained in a shorter period, and apparently at a lower temperature.

This small amount of oxide of iron does not act like the oxide of iron present in an inadequately deoxidized steel which results in the formation of blow holes, possibly due to a reaction, in the higher plastic ranges, between oxide of iron and carbon. There is no evidence of any

undesirable action as a result of its presence.

As this condition of low fluid life in a steel, satisfactory in respect of chemical composition ordinarily determined and of temperature, may be remedied by an addition of iron oxide to the bath of metal, either direct to the metal or to the slag, the steel is logically designated as *over-reduced*.

In the usual acid electric steel practice the melter's count test is used as a measure of fluidity. The best method of applying this test is to pour a sample of the steel into a standard open core-sand mold, as shown in Fig. 1, (page 58) noting the seconds required for the sample to film over. This is a much more accurate indication of fluid life than can be obtained by allowing a spoonful of metal to set in the spoon, for in acid practice the slag may become more unmanageable than in basic practice, and as a result the spoon may become heavily coated with slag, thus holding a smaller amount of metal, or may become coated with a light slag covering and hold a larger amount of metal. Varying quantities of metal in the test spoon are likely to affect conclusions wrongly.

Molds Have Spill Gate

These core sand molds are of a capacity somewhat less than the spoon and are provided with a spill-gate, so that samples of uniform size are obtained. A sample of metal is taken from the furnace in a spoon and poured into a core mold, any excess metal flowing out through the spill-gate. Once the spoon is emptied time starts and the seconds are counted until a film completely forms over the surface of the metal in the core. In a highly fluid metal small specks of film appear and move about on the surface, some being reabsorbed and later reappearing. In a metal of low fluid life, a film quickly forms over the surface of the sample and even though an otherwise satisfactory second count is obtained, this quick-forming film may be taken as an indication of a condition unsuitable for the production of light steel castings.

This over-reduced state is apparently due to the maintenance of severe reducing conditions in the furnace during which time nascent silicon enters the metal. Nascent silicon appears to exert a stronger deoxidizing action than does silicon added in the form of a ferroalloy. In fact its reaction seems to be stronger than that of aluminum though of course not so rapid.

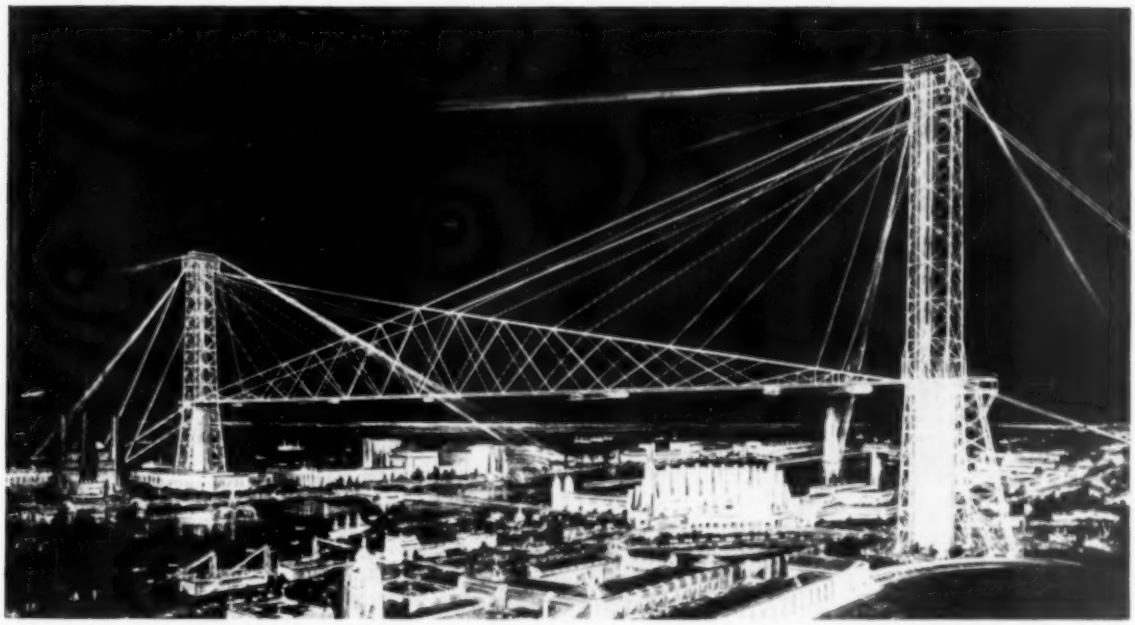
When tests of normal steel are made before and after the addition of the finals it will be found that the use of silicon and manganese has reduced materially the fluidity of the metal. Considering that there has been only a slight drop in temperature upon the addition of these finals, along with an appreciable increase in carbon and manganese content (both of which elements should increase the fluidity of the metal), it is found hard to correlate the two unless it is ascribed to some obvious constitutional difference other than the modification of carbon, manganese and silicon contents. As manganese and silicon react with the iron oxide present it is to be assumed that the constitutional change consists of a lowering of the iron oxide content. However it is significant, that an addition of ferrosilicon and ferromanganese to a steel which appears to be over-reduced does not produce a serious decrease of the fluidity (already low) but in some instances has produced a slightly higher fluidity. It is not possible to prevent this marked decrease in fluidity in a normal steel upon the addition of the finals, but it is possible to prevent the low fluidity condition brought about apparently by severe reducing conditions in the furnace, when nascent silicon enters the metal.

It is significant that when this low fluidity condition does arise it may be cured by returning to oxidizing conditions in the furnace. While this is a cure for the deficiency, it is best to adopt preventative measures, so making the steel that the over-reduced condition is avoided.

Foundrymen who have had experience with both electric and converter steels claim a greater life for the latter. Considering the procedure followed in making converter steel it can be seen easily if the over-reduced theory is considered, why this should be so, and why they do not need such large risers for converter steel as for electric steel.

Could Not Pour Heat

A striking example of this over-reduced condition in acid electric steel follows: A particular order specified steel of 0.15 to 0.20 per cent carbon, 0.50 to 0.60 per cent manganese and 0.60 to 0.80 per cent silicon. It was decided to introduce the desired silicon content by reduction from the slag even though it was realized that it would be nothing but a guess, due to the inability to judge it by cup after about 0.30 per cent was present. The heat progressed unsatisfactorily throughout, particularly near the finish when, with an estimated silicon content of 0.50 per cent, it was impossible to get a fluidity reading of more than 18 seconds, a complete film, suddenly and without warning, forming over the sample of metal after this short lapse of time. As most of the heat was to be poured in handshanks it was realized that this fluidity was unsatisfactory. Finally at the expense of temperature and refractories a time count of 25 seconds was obtained, the manganese added and the heat tapped. Although the ladles were satisfactorily heated the metal froze on the lips. It being impossible to pour it, the metal was put back into the furnace, ored down, worked and finished, the desired silicon being added as ferrosilicon. Though no hotter, if as hot as previously, the metal poured in normal manner throughout the heat. At first (*Please turn to page* 50)



Artists sketch of Sky Ride, now being constructed at a Century of Progress

A. F. A. Plans Program for Chicago

Technical sessions, exhibition of equipment and supplies, and fair provide attractions

PROBLEMS of interest to all branches of the foundry industry and questions of particular importance to each of the various subdivisions of castings manufacture, are included in the technical program for the annual convention and exhibition of the American Foundrymen's association to be held in the Stevens hotel, Chicago, June 20 to 23. In addition, A Century of Progress, the Chicago Fair, offers an additional attraction never before equaled on the history of the association.

Foundry costs will be given the center of the stage on Tuesday afternoon, the opening day of the convention. A four act play under the direction of the association's cost committee with the co-operation of A. E. Grover, cost consultant, the Gray Iron institute, Cleveland, will dramatize a problem that in some form touches every foundry. The second general session, covering "Good Housekeeping," a subject of vital importance to every foundry owner, was announced in more detail in the February issue of THE FOUNDRY. A third subject of interest to every branch of the industry, namely "Materials Handling," will be considered at a joint meeting sponsored by the recently formed joint committee of the A. F. A., and the Materials Handling division of the A. S. M. E. special consideration will be given to handling problems of the small foundry under present operating conditions.

Ambitious programs are being arranged for the four branches of production. In steel founding, three sessions will be provided, one to deal principally with test methods, and the other two to consider various alloys in steel castings. Two sessions will be devoted to malleable iron manufacture, the first being a round table luncheon meeting on Wednesday of the convention week. A round table luncheon and two regular sessions are being arranged for the nonferrous division.

Gray iron will occupy a prominent spot in the convention picture. One of the important meetings on that subject will be a joint gathering with the American Society for Testing Materials on Friday, and will be devoted to gray iron specifications and tests. Other sessions will cover electric melting and general practice. A symposium on gray (*Please turn to page* 58)

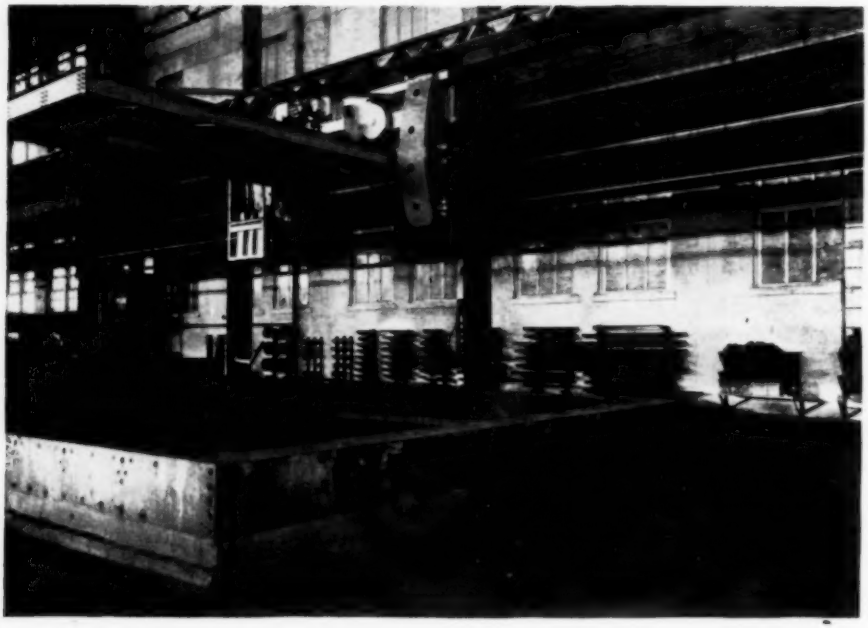


Fig. 9—Racks provide storage facilities for spindles and other equipment for sweep molding

Good Housekeeping at Falks

Program materially improves conditions from the standpoint of cost and health to employes

By V. J. HYDAR

Apprentice Supervisor, Falk Corp.

IN FURTHERING the good housekeeping program at the Falk Corp., Milwaukee, which was described in part in the February issue of THE FOUNDRY on page 10, a wash room with accommodations for 213 men was built on a balcony floor directly above the supply room. It is equipped with eight fountains, each of which will accommodate eight men. Benches, waste paper cans and other conveniences are provided. The wash room, as well as the supply room below, is equipped with sprinkler protection against fires. It is nicely appointed with rubber mats on the painted concrete floor and brass kick plates on the doors at each of the two entrances to the room. The men make every effort to keep the place clean and an attendant is responsible for the order of this and other locker rooms.

A similar wash room located near this one has accommodations for 96 men and steel lockers have been put into various places in the shops for the convenience of the workmen.

Fig. 10—Large core room, where all brick and masonry has been painted white, and all structural steel aluminum

In line with the general cleaning up idea, provisions have been made for the racking of spindles and other equipment used in the making of sweep molds and large molds in the pits. Similar provisions have been made for the racking of the rails, bars, screws and other clamping devices for heavy jobs. The savings in time in getting the necessary supplies for such work should soon pay for the cost incurred in building these racks. Formerly, a helper had to spend considerable time in turning over heaps of such equipment to find the proper pieces. It may be noted from Fig. 9 that the brick wall in the background has been painted white, materially brightening up an otherwise dark area in the shop.

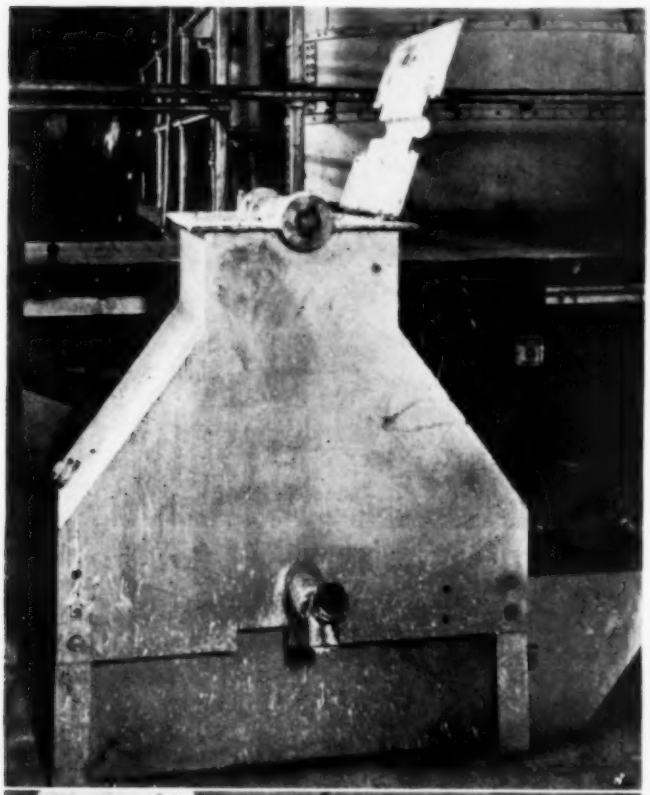


Fig. 11 (Above)—A mixer specially constructed to mix mold wash. Fig. 12 (Below)—The hinged cover may be closed to prevent splashing

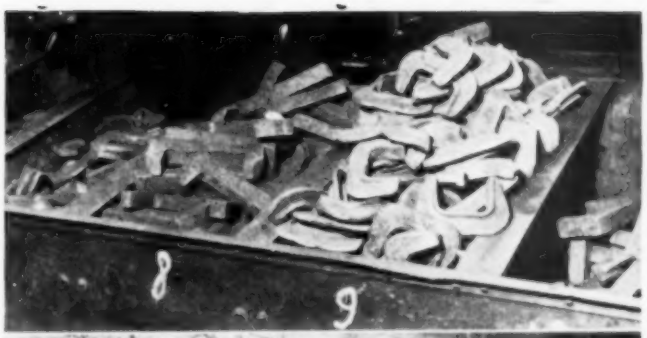


Fig. 13 (Above)—Special storage is provided for clamps. Fig. 14 (Below)—A recently constructed space for heads and gaggers

Other efforts at cleaning up can be noticed in Fig. 10 which shows the green sand floor of the large core room. The roof is of sawtooth construction and, combined with the large glass area on the north wall of the building provides ample daylight in almost any kind of weather. The illustration which has been reproduced from a photograph taken in the afternoon immediately after the day's work had been cleaned up shows how the floors are swept and everything is arranged neatly for the coming day.

Handling Facing Sand

Fig. 15 which is a view taken near the west end of the same floor shows the sand control laboratory and the discharge belts from two of the facing mills which are used in mixing core facing. The small wooden box in the foreground is used for storing sling chains and ropes when they are not in use. Boxes shown under the spout from the facing mill are for the transportation of facing to the core room floor. They are of welded steel construction, made to our own design and the curved lugs at the upper corners of the boxes provide for hitching to the crane. The lugs were cast in our foundry and welded to the boxes. The upper edges of the

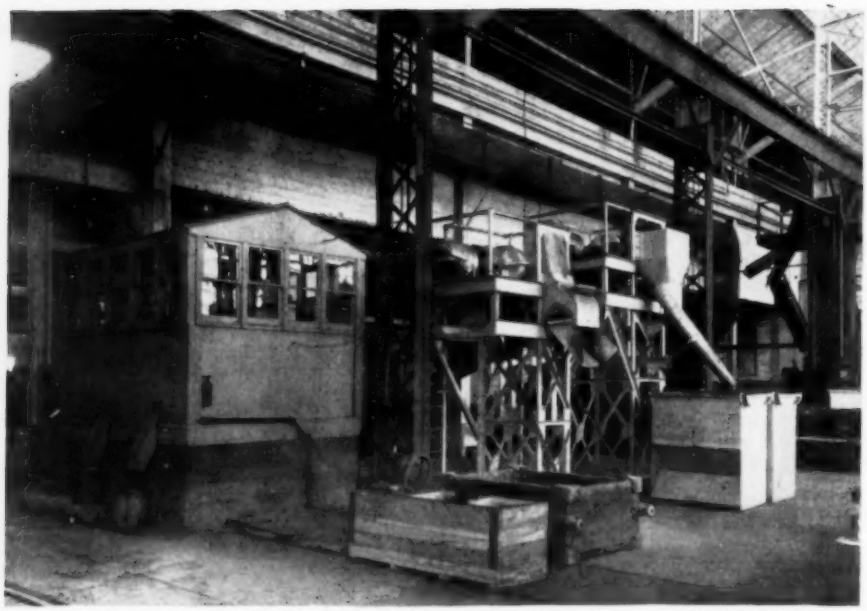


Fig. 15—View of the large core room showing discharge end of the facing mills. Boxes under the spout are of steel construction

boxes are flanged to give additional stiffness and are protected against corrosion by a heavy tar base paint on the inside and aluminum paint on the outside. The doors at the bottoms of the boxes are hinged and are held open by hasps which are welded to the faces of the boxes. A row of these boxes is arranged along the wall of the core room shown in Fig. 10.

The old job of hunting over the entire shop for heads has been overcome largely by the storage space shown in Fig. 14. Heads are shelved according to size and the men who use them are held responsible for putting them back in their proper places. What is perhaps a still greater saving is the practice of reclaiming gaggers, bundling them together with wire and labeling them according to length. Formerly, a couple of old pensioners were given the job of straightening gaggers, as best they could, with the use of a hammer and an anvil. The straightened gaggers were thrown indiscriminately into a heap in one corner and it seems that there were never enough good ones of the right size for any sizable job. Helpers frequently spent a half day at a time hunting gaggers for the large molds and any time of the day would find several of them at the heap. New gagger rod was continually being requisitioned from the store room and the entire arrangement was quite expensive and rather inefficient.

A pneumatic rod straightening machine has been installed for the purpose of reclaiming gaggers and the same two old timers can now turn out their work much more readily and have plenty of time even for bundling and labeling. The shelving shown in Fig. 14 is located on the large molding floor where the gaggers can be had without the necessity of a long walk to the gagger pile for them.

Along the same lines is the bin for clamps which is shown in Fig. 13. The bin will be repainted and the compartments marked according to the sizes of the clamps in them. A compartment is also provided for wedges and, again, a great deal of the helpers' time has been saved by this installation to care for clamps and wedges.

Another money saver is shown in Fig. 11. This is a motor-driven mixer for mold wash. It was designed and built in our shop and is made of heavy steel plate welded together. The paddle, or agitator, is shown in the interior view of the same mixer in Fig. 12. It is driven by a small electric motor and the hinged cover can be closed to prevent spattering. A supply of wash can be taken from the mixer through the tap shown in the front on Fig. 11 and the quantity that is not used can be emptied back into the mixer.

Formerly, each helper had to make the wash for the job on which (*Please turn to page* 61)

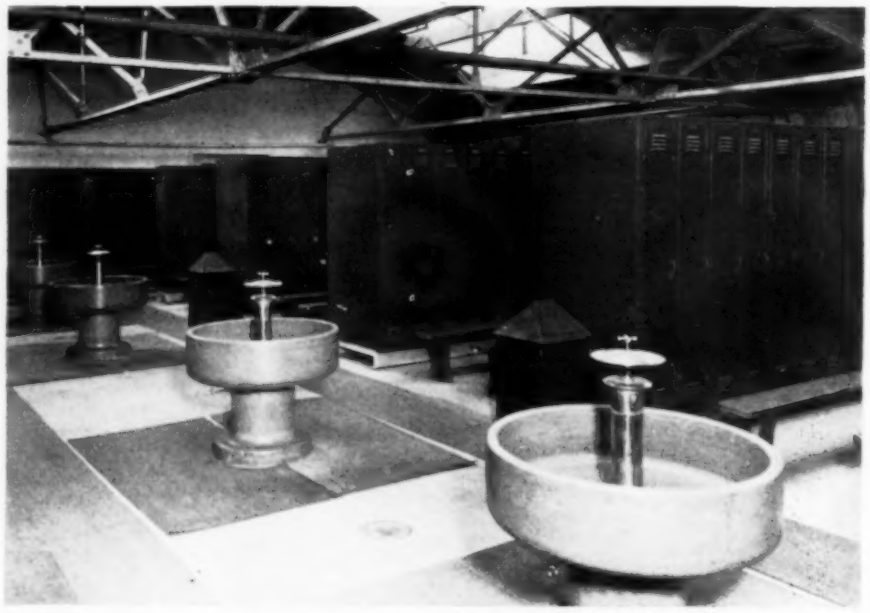


Fig. 16—A locker and wash room, located immediately above the supply room, has accommodations for 213 men

Heat Treating Gray Iron Castings

Methods include normalizing, quenching and drawing, annealing, and nitriding

By JOHN W. BOLTON

Lunkenheimer Co., Cincinnati

SOME knowledge of graphitization and reactions of metalloids is a prerequisite to intelligent heat treatment of cast iron. It is obvious that if maximum softness is desired the temperature of a pearlitic cast iron must be carried somewhat above the transformation range and that cooling through and for a couple hundred degrees below this range must be slow. Such an annealing or softening treatment produces a material composed almost wholly of ferrite and graphite. On the other hand if hardening is the objective it is necessary to go considerably above the transformation point and to quench through quite rapidly. The higher the temperature the more carbon in solution, hence the greater hardenability in theory.

Requires High Temperature Annealing

When cooled rapidly or chilled the cementite austenite structure is shown. Irons of this structure are known as white irons and are intensely hard as cast. Intermediate types, between white iron and gray iron are known as mottled irons. These contain cementite and graphite both, as well as austenite (or at room temperatures) martensite or pearlite. It sometimes is desired to soften such irons, as the free cementite or chill is very hard to cut. This usually requires higher temperature annealing than is needed for straight gray iron.

Black graphite flakes which are soft and nontenaceous weaken the matrix of the iron considerably. They are one of the distinguishing structural features of gray iron as opposed to steel (except in rare cases steels do not contain free graphite). The amount, size and distribution of graphite flakes are major controlling factors determining many of the physical properties of gray cast irons. Control of graphitization is important, not only to the founder, but also to the heat treater.

The pearlitic matrix is characteristic in most gray irons. Alternate lamellae of cementite and ferrite, and the general resemblance of this structure to that of pearlite in steel may be noted in micrographs. A completely annealed gray iron, consists wholly of ferrite and graphite flakes. This ferrite is similar to that found in pure iron and in low carbon steel. Martensitic structure is obtained by proper quenching treatment.

Results of Alloying Elements

This exposition of the principles underlying heat treatment of cast irons has been confined largely to consideration of rather pure iron carbon alloys. Commercial cast irons are alloys of iron, carbon and silicon, plus manganese, phosphorus, and sulphur, and in many cases *alloying* elements, such as nickel, chromium, molybdenum and the like. The influence of these elements on heat treatment results may be briefly summarized as follows:

SILICON—Silicon in cast iron may range from below 1 per cent up to possibly 3 per cent. It is what is known as a graphitizing element. For a given sized section the amount of graphitization, the relative percentages of graphite and combined carbon, can be controlled to a large degree by adjustment of silicon content. Silicon also lowers the amount of carbon required for the eutectic, changes the pearlitic transformation range, and in other ways modifies the properties of the iron.

SULPHUR AND PHOSPHORUS—Although the effects of sulphur and phosphorus are important from the foundrymen's viewpoint they may be disregarded, merely mentioning that in sufficient amounts, manganese depresses the critical range.

NICKEL—In amounts up to slightly over 1 per cent nickel, has a mild graphitizing action and does not interfere with annealing. It lowers the critical range and decreases the critical quenching speed. The lowering of the critical point by nickel is so marked that at from 4 to 8 per cent nickel the metal will be largely martensitic in the as cast state, and at 18 or 20 per cent nickel it is largely austenitic.

CHROMIUM—This element is a carbide stabilizer, tending to inhibit graphitization. It is said to raise the transformation range, but

also to decrease the critical quenching speed.

MOLYBDENUM—Molybdenum is a carbide stabilizer, lowers the transformation range and decreases the critical quenching speed.

It will be obvious that in some cases the proper use of alloys will facilitate heat treatment by quenching. Lowering of critical range, some stabilization of carbides, and lowering of critical quenching speeds are definite advantages, frequently resulting in easier manipulation, less drastic treatment, and probability of greater toughness in the finished product. On the other hand, elements like chromium and molybdenum, carbide stabilizers, may cause difficulty in annealing.

Factors on Heat Treating

In the majority of commercial nonalloyed cast irons the pearlitic transformation occurs around 1325 to 1340 degrees. In some of the alloyed irons it, of course, is somewhat lower.

The following ABCs of cast iron heat treating practice must be observed:

1—If good results are wanted, the original castings must be of good close grained material, desirably low in carbon content, say 2.70 to 3.20 per cent, and with a largely pearlitic matrix—i.e. the combined carbon should be somewhere from about 0.50 to about 0.70. Coarse open grained irons do not heat treat well. High-carbon high-silicon irons should be avoided.

2—All cast irons are relatively nonductile. Placing cold castings, particularly those of complicated shapes, into a hot furnace is quite likely to cause cracking. Safest practice is to preheat to 500—600 degrees Fahr. before placing in a hot furnace.

3—Drastic quenching treatments are to be avoided, and quenched castings must be drawn if toughness is to be maintained.

4—In quenching treatments, long holding at temperature will cause trouble.

The principal commercial heat treatments applied to gray cast irons are as follows:

1—Normalizing, aging, or low temperature annealing, to relieve internal stresses.

2—Dead or softening annealing to increase machinability.

3—Quenching and drawing to increase hardness and wear resistance.

4—Nitriding.

In case of chilled or mottled irons another or fifth type of annealing is used, which is called a chilled iron anneal. The regular anneal for white iron used in the production of malleable, or malleable cast iron, will not be discussed here.

Many castings, particularly those with uneven sections, have internal stresses. These, if not relieved, frequently cause warpage and in extreme cases have been known to cause cracking. In precision work former practice was to allow the castings to *age* for periods from a few days up to several months or more. This practice was time consuming and not always efficacious.

In other cases, castings are used at fairly high temperatures and must maintain their dimensions under operating conditions.

Low temperature annealing or quick aging to remove internal stresses consists in heating to about 900 degrees Fahr., holding from 1 to 8 or 10 hours (depending on the casting), and cooling slowly to well under 450 degrees Fahr. before removing from the furnace. The object is to get the metal plastic enough to allow relief of internal stresses without getting into the temperature range where graphitization takes place. In most close grained irons graphitization at 900 degrees Fahr. is extremely slow, hardly appreciable over a few hours. In case of open grained irons it may prove desirable to drop the temperature say to 800 degrees Fahr. This type of *quick aging* causes little change in the physical properties of the metal.

In other cases some slight softening as well as stress relief is desired. This is accomplished by running the temperature up to 1000 or even to 1150 degrees, depending on the time and on the amount of softening desired. This softening usually results in some slight loss in tensile strength.

Dead or soft annealing of gray iron requires heating above the transformation point, holding a sufficient time to allow complete penetration of temperature and cooling slowly down to well below the pearlitic transformation. The annealing temperature usually employed is about 1450 degrees, followed by slow cooling to 900 degrees or under. In the presence of certain alloys it may prove necessary to increase the temperature or time or both.

May Cause Graphite Grain Growth

Dead annealed cast iron is soft, usually about 120-140 brinell, depending somewhat on the total carbon content and on the silicon content. In presence of alloys the hardness may be somewhat higher. Dead annealed cast iron is an easily machined ferrous alloy. Its strength is somewhat lower than that of the original cast metal, usually by 10 to 25 per cent.

Too high annealing temperature or too long annealing time or both may cause some graphite grain growth, with consequent detriment to the properties of the metal.

Completely chilled irons usually require higher annealing temperatures than gray irons, often 1600 degrees to 1750 degrees, and in some cases several hours may be required before the cementite is fully broken up. Castings with small chilled spots in fins, small sections, etc., often cause the annealer trouble. To eliminate the hard spots it is necessary to anneal. Sometimes a regular 1450 degree anneal will suffice, sometimes a higher temperature is required. Without some experi- (*Please turn to page* 62)

Steel Casting Classifications

Market quotations and differentials applied to cast steel commodities

By DAN M. AVEY

PROGRESS and leadership have been actively in evidence in the steel casting branch of the foundry industry during the span of 60 or more years of steel casting production. A high type of executive ability and management talent has been identified with steel foundries. This is evidenced in the growth of production and use of steel castings. From a total of 216,000 tons in 1900 to 1,773,000 tons in 1929 the advance has been regular and only an occasional lag has been encountered.

Technique and Production Emphasized

This steady growth has been a tribute to ability along technical and production lines. The improvement of product, the adaptation of steel castings to a wide range of commercial uses, and the acceptance by such a wide variety of commercial and industrial consumers attest this fact. While some manufacturing lines have built and operated their own steel foundries, it is estimated that 83 per cent of the total tonnage of steel castings produced has been made available through jobbing sources. With about 300 steel foundries listed in 1929, 240 were reported as manufacturing castings for sale. The annual sales of these commercial steel castings were estimated as in excess of $175,000,000 during the period immediately preceding and including 1929.

While no summary has been made of the capital investment required, it it reasonable to assume that it was at least equal to the annual volume of sales reported. The total involved shows the stature of the steel foundry branch among industries.

Against the splendid record of accomplishment which is reflected in the growth in production, the business record as reflected by statement of profits is not commendable. A survey of the net earnings of a representative number of foundries representing a cross section of the various types of plants and also reflecting the range of steel castings produced shows that for the period from 1924 to 1928 inclusive, the average earnings represented only 4.8 per cent of assets and with a capital turnover of 0.83 per cent. With such a low record of return during a prosperous period, the disastrous effects of the depression era upon the industry readily may be understood. One foundryman recently stated that during 1932, the loss per ton of steel castings produced throughout the industry had been $45 to $50 a ton.

In the steel foundry industry no less than all others, the evils incident to the period have prevailed. Recognition of the fact that over-capacity existed was no deterrent to the industry at large in the fight for business. The spiraling decline in prices was accelerated by a tendency to price for volume which of course did not materialize. Demand was not stimulated by reducing prices. The descending line of steel casting production was unhampered by the continued offering of lower and lower quotations.

Study Merchandising Problems

In the past five years leaders in the steel casting industry have devoted much time and energy to those commercial phases of their business which perhaps were subserved during a time that production and quality problems were more urgent. Sales conferences and clinics, trade association meetings and studies of costs and merchandising methods have been followed consistently by the steel foundry industry. All of this work and strenuous endeavor has reached and halted before one definite obstacle. This has been the lack of a common basis or understanding which would permit the buyer and seller of steel castings to correctly evaluate the product.

Probably no single branch of the metal working industry serves a wider range of commercial and manufacturing interests than the steel castings industry. The largest customer class, of course, is the railroads, which normally consume from 40 to 50 per cent of the commercial steel castings. Next in order of importance is the steel or rolling mill industry using perhaps 10 to 15 per cent of the total yearly output. Then come a variety of consumer classes like excavating, mining, road- (*Please turn to page* 46)

Reproduction of the bronze statue of "The Molder" which was fashioned by Frederick C. Hibbard

Through the years with THE FOUNDRY

ON NEW Year's day ten years ago, few individuals or institutions apparently realized that this country, and for that matter practically all of the civilized world, was on the threshold of the period of greatest prosperity in our history. Looking back now at the factors which were partially visible at that time, it seems so easy to discern the symptoms of that "bigger and better' ambition, so aptly called "elephantitis" by a recent writer, which probably were the most important factors in today's industrial turmoil. But the student of economics and the business man alike, while expecting a highly satisfactory business turnover, never anticipated the extent to which business in general was to soar.

Foundry Business Improves

THE FOUNDRY, early in 1923, reported prospects bright for foundry business. Later in the spring it stated equipment sales were climbing. May found "continued high rate operations characterize foundry conditions, throughout the country." The customary summer lull did not develop until late in the season and then was extremely mild. Trade trends through the various months indicate business while not heavy was satisfactory throughout the remainder of the year.

Nevertheless, THE FOUNDRY was more interested in men and machines, in important trends in foundry practice and activities of leading individuals in the various branches of the industry, than in covering the economic situation. As had been the case in the previous 30 years of service to the industry, THE FOUNDRY was interested mainly in pointing the way to future progress in manufacture and sales. While many readers remember well the days of the early twenties, it should be of interest to recall the high spots in foundry news of that period.

The Ohio State Foundrymen's association met in Middletown, O., and, according to the Jan. 1, 1923 issue, elected the following officers: President, F. W. Huber, American Rolling Mills Co., Middletown, O.; vice president, J. H. Bruce, Bowler Foundry Co., Cleveland; treasurer, Walter Seelbach, Walworth Run Foundry Co., Cleveland; secretary-manager, Arthur J. Tuscany. The same issue also carried a complete discussion of the vibratory precipitation method for testing molding sand, as developed by Eugene W. Smith. This test has found practical application in many foundries since that time. The same issue told that Frank J. McGrail was appointed general superintendent of foundries of the Westinghouse Air Brake Co., Wilmerding, Pa.

Suggests Electric Melting

Larry J. Barton had conducted a survey on the Pacific coast, and in the Feb. 1 issue showed the possibilities of success in producing iron and steel in the electric furnace in that district. The Wilson Foundry & Machine Co., Pontiac, Mich., was heating sleeve castings for a Knight engine in a tunnel furnace of the muffle type to relieve strains, according to an interesting article. In the following issue, the cast bronze towers for guarding traffic on Fifth avenue in New York were described, and Charles Pack discussed two types of machines used in die casting manufacture.

Annealing gray iron was a live subject, as evidenced by an article by J. H. Harper and R. S. MacPherran covering the effect of annealing on

that type of casting. The idea that many castings could be made in permanent molds had increased in popularity, and in the March 15 issue, THE FOUNDRY pointed out that the development of permanent molds was a live subject. The Hudson-Manhattan tubes were under construction at the time, with the segments manufactured by the Bethlehem Steel Co., Bethlehem, Pa. An article in April 1 issue described foundry methods at that plant.

The annual convention of the American Foundrymen's association was held in Cleveland in 1923, the new Public Auditorium being the center of activities. Ralph H. West, West Steel Casting Co., Cleveland, was chairman of the local entertainment. The meeting was a big success, the registration exceeding 4000. For the first time since the first convention in 1896, a daily edition of THE FOUNDRY carried spot news of all activities. G. H. Clamer, Ajax Metal Co., Philadelphia was elected president of the organization.

Activities Reviewed Briefly

Highlights of the remainder of the year must be reviewed briefly;—Dr. Moldenke described the permanent mold machine of the Holley Carburetor Co.; An International Foundry Congress was held in Paris and an American party enjoyed greatly the wonderful hospitality of the foundrymen of Europe; C. R. Messinger, former A. F. A. president, was elected president of the Chain Belt Co., Milwaukee; Enrique Touceda and John Howe Hall were awarded the John A. Penton and the J. H. Whiting medals by the A. F. A.; H. A. Fromelt wrote on "Training Foundry Apprentices"; centrifugal casting of pipe by the deLavaud method was described; Vincent Delport, now European manager of THE FOUNDRY, covered the Paris meeting; Francis D. Bowman, Carborundum Co., Niagara Falls, N. Y. presented some practical hints on polishing; John Grennan, University of Michigan experimented with a cupola to determine melting behavior and the Griffin Wheel Co installed a preheater for its cupola blast.

In the Jan. 1 issue, 1924, Bill, that famous friend of Pat Dwyer's, told how to make the cup, saucer and spoon mold. The following number described the tunnel kiln installed by the International Harvester Co., Chicago, to shorten the annealing time for malleable castings.

The foundry world was shocked when it was announced that Harry E. Diller, metallurgical editor of THE FOUNDRY, had died on Jan. 17. Through his writings and activities in technical phases of foundry practice, Mr. Diller was recognized as one of the best authorities on the subject. Several months later, George A. Drysdale was made metallurgical editor.

Manufacturing methods attracted considerable interest during the year. F. A. Melmoth, then located in England, but now vice president of the Detroit Steel Casting Co., was the author of an article on British practice in the manufacture of steel castings. A three story foundry of the Lavelle Foundry Co., Indianapolis, was described in considerable detail. E. C. Barringer, then Chicago representative of THE FOUNDRY and now managing editor of *Steel*, described operations at the Nugent Steel Castings Co., Chicago. Use of the sand slinging machine in the manufacture of bath tubs at Falkirk, Scotland, featured one issue, and the new foundry of the Studebaker Corp, South Bend, Ind., was described in another.

Research and invention were not neglected in material presented in the editorial pages. An extensive article by V. E. Hillman, Crompton & Knowles Loom Works, Worcester, Mass., was entitled "Hunting Ills with the X-ray." R. L. Binney and N. I. Terbille described an interesting device with multiple axes for the manufacture of centrifugal castings. The first report on the work of the joint committee on molding sand research, which was sponsored by the A. F. A., was presented in the Sept. 1 issue. Along the same line, H. O. Haughton discussed the work to be undertaken by the committee appointed to develop standards for pattern equipment.

Starts Several Features

During the past ten years, THE FOUNDRY has printed a number of highly valuable serial articles, some of which have been published later in book form. The June 1 issue in 1924 carried the first chapter of the book *Refining Metals Electrically*, by Larry J. Barton. The following issue carried the first of a group of articles on various phases of patternmaking published over a period of several years, which were prepared by Walter C. Ewalt. The first article discussed the production of patterns for casting the globe valve. A feature "Milestones in Foundry Practice" a series of reviews of the serious and frivolous facts in foundry history, first appeared in the July 1 issue and continued monthly for several years.

The A. F. A. Convention in 1924 was held in Milwaukee. In the preconvention issue, THE FOUNDRY sounded a call to arms when, in an article entitled "Meeting the New Competition," it stated that an "era of specialization with excess plant capacity brings foundrymen face to face with new conditions." The convention was a success from every standpoint, with a registration of 5000, the largest up to that time. Louis W. Olson, Ohio Brass Co., Mansfield, O. was elected president.

The New Year brought several changes in THE FOUNDRY. The format was changed, head type was made larger and head presentation varied, several features added, and for the first time in many years, the names of the editorial staff were presented in each (*Please turn to page* 58)

Cupola Practice for Malleable Iron

Exacting control of factors and careful selection of raw materials are necessary

By HERBERT H. FARR

Rudisill Foundry Co., Anniston, Ala.

THE cupola is the heart of operations in the malleable foundry using that melting medium. Once correct practice and standards are established and ideal melting conditions realized, every operation should revolve around the cupola. If molding conditions change so that the full capacity of the cupola can not be utilized, it is better to line down the stack, change the air, etc., than to slow down or make the cupola meet the changed conditions. In other words, the melter should not be expected to get 6¾ tons per hour one day and 5 tons per hour the next. If conditions change so that 5 tons per hour is all that can be used, then the cupola should be changed to one of that capacity.

Zones of Action in Cupola

Certain well-defined zones of action, found in every cupola, should be maintained, otherwise slow, irregular melting, cold iron and excessive oxidation will result. Starting at the bottom and going up the stack the zones are as follows: Crucible zone; tuyere zone; melting zone; charging zone; and stack.

The crucible zone extends from the sand bottom to the bottom of the tuyere and in a continuously operated cupola, should be 4 to 6 inches. The tuyere zone extending from the crucible zone to the melting zone is the place where the air comes in contact with and burns the hot coke. Wind pressure to a large extent will regulate this zone, which should be held within a few inches above the top of the tuyere. The melting zone is the space immediately above the tuyere and is probably the most important. It should extend from the top of the tuyeres upward from 40 to 48 inches. Iron is not melted above or below it and the actual melting occurs through the upper 8 inches. The part extending from the melting zone to the top of the last charge of iron placed in the cupola is called the charging zone. The stack is that part of the cupola extending from the top of the charging zone to the top of the cupola. Modern practice is to make the diameter of the cupola the same from the crucible through the stack.

Excessive oxidation probably is the greatest evil with which the cupola melter has to deal. This is caused by a number of conditions, one being high wind pressure delivered through small blast pipes into and through small tuyeres. It is not the pressure entering the cupola that counts but the volume Long experience has shown that a certain relation of tuyere area to cupola sectional area is necessary if proper penetration of the blast is obtained. If the tuyere area is too small the velocity of the air will be so great that penetration toward the center of the cupola will be too strong. Coke near the tuyeres will show black and the power consumption of the blower motor also will be increased.

On the other hand, if the tuyeres are too large the velocity of the air will be so low that instead of penetrating into the bed it will travel upward around the cupola lining leaving a cone of unconsumed coke in the center of the cupola. Tuyeres should be so flared that their inside openings will be nearly continuous around the circumference of the cupola, thus admitting the same volume but softening its force.

Combined Opening of Tuyeres

Ordinarily, it is good practice to make the combined tuyere opening or area (this is from the wind box side) equal to approximately ⅛ that of the cross-sectional area of the cupola. For example the sectional area of a 54-inch cupola is 2290.2 square inches. One-eighth of that area would be 286.3 square inches, which should be the combined area tuyeres. Using six tuyeres the area of one tuyere would be 1/6 of 286.3 or 47.6 square inches. Therefore, a tuyere 3½ x 14 inches would be suitable.

Blast pipes should be large enough to convey air freely from the blower to the cupola. It is a good plan to have them a little larger than the blower outlets; never smaller. Abrupt bends are to be avoided and the blower should be near the cupola. The blower inlet should

provide a supply of fresh clean air. The matter of blast pipe entrance to the wind box or air chamber makes little difference. Some foundrymen like to have pipes enter on the line of a tangent while others prefer to have them designed so that they enter the top of the wind box. However, with either arrangement it is a good plan to place the tuyeres so that none of them will fall directly in front of the blast pipes, thus giving the same volume of air to each tuyere.

No matter how carefully the cupola, blast pipes, blower, etc., may be arranged, coke or rather poor coke, can become a source of trouble. The melter may be capable and first class in every respect but with poor coke oxidation will result and he will never be able to produce good consistent malleable iron. There is no economy in using cheap coke. The melter must be on the alert constantly and his efforts should not be paralyzed by the necessity of using poor coke.

Coke for the malleable cupola should be dense, low in sulphur and volatile matter and high in carbon. Density which of course is a physical quality, is absolutely necessary and coke with high cellular space should be avoided. The coke should be dark gray in color, hard, lustrous and free from black ends. The practice of adding extra coke during a heat to raise the carbon will never be necessary provided good coke is used and other conditions are right.

Bed for Malleable Cupola

The bed for the malleable cupola should extend from 40 to 48 inches above the top of the tuyere, and it is better to start with a high bed. It is much less disastrous to come from the high to the low than to go from the low to the high bed.

In connection with the operation of a malleable cupola, without doubt one of the most important details is putting in the bed. In the first place, the coke to be used should be hand-picked and large dense pieces selected. Half of the coke bed should be charged first and lighted evenly. If extreme care is not used, one side of the bed will show dark while the opposite side will be almost white hot. If that condition is not corrected immediately trouble will surely follow. By watching the burning of the bed closely, draft may be regulated by opening and closing the tuyeres, which will cause the coke to burn through evenly. When that much of the bed has been ignited the remainder of the coke is added. This should be done by hand, and the correct height regulated by a measuring rod let down from the charging door. The coke should be level by all means. It may seem like a small detail, but by overlooking it a day's run may be ruined.

Flux then is added. If limestone is used, from 2 to 5 per cent of the metal charges will be sufficient, depending on the quality of the coke, scrap and steel added. However, if poor limestone is used an extra burden is added to the coke and frequently does more harm than good. Good limestone should contain about 90 to 95 per cent calcium oxide. If one or two bricks of fused sodium carbonate is added with the limestone, the slag formed will be more fluid and more sulphur will be eliminated.

The metal should be charged just as carefully as the bed. Steel should be charged first and distributed evenly over the coke. Following the steel, malleable scrap, remelt such as gates, sprues from previous heats, pig iron, and the ferroalloys (silicon and manganese) are then added in the order named.

Five or Six Charges Sufficient

Coke for the second charge then is added, followed by the flux, and the next metal charge, and so on until five or six charges have been placed in the cupola. Coke should be charged by measure and metals by weight. If the charging door is higher than five or six charges, it is best not to charge all the way up.

First iron should show at the spout in 10 or 12 minutes from the time the blower is started. If more than 12 minutes are required, the bed is too high and steps should be taken immediately to lower it. This can be done by cutting the next few coke charges 2 or 3 inches. If iron shows up under 10 minutes from wind-on, it is possible that the bed is too low and trouble with cold dull iron will be encountered. The bed can be raised by charging extra coke for a few charges.

The melter should make the timing of *first iron* after *wind-on* a part of his daily routine. After noting this time, he should read the temperature of the metal with an optical pyrometer. This should not be less than 2700 degrees Fahr. If the temperature is lower corrections must be made at once. The coke bed might be of the proper height but of poor quality.

As soon as the mixing ladle is full enough to turn out metal a test bar should be made. A bar 1—1¼ inches in diameter is sufficient. If after breaking the bar, it is found that the fracture is white or perhaps with a few carbon spots the days melting may proceed.

It should be remembered that too much coke frequently is as harmful as not enough. Adding extra coke to raise the carbon should be only a temporary measure and it is much better to check the metals entering the cupola or possibly change the mixture rather than burden the stack with too much coke. If the standard coke charge is going in and it is found that this is matched with the correct amount of air, the addition of an excessive amount of coke will mean longer blowing to get the same melting.

Selection of raw ma- (*Please turn to page* 60)

Fig. 1—Maritime ancestry and environment is reflected in many creations. Fig. 2—Vigor and boldness of treatment characterize his human figures. Fig. 3—The horn blower

Sculptor Reproduces Work in Bronze

Carl Milles exhibits cast bronze figures at art galleries in many American cities

CONTEMPORARY with a recent visit of Carl Milles the noted Swedish sculptor to the United States, a number of his works, either originals or reproductions, were placed on exhibition for varying periods in the art museums and art galleries of the principal cities. The figures presented in the accompanying illustrations constitute part of the group shown in the Museum of Art in Wade Park, Cleveland.

These figures are cast in bronze, a few of the great number Milles has created in the past 30 or 35 years. He was born June 23, 1875, near Upsala and started his career as a boy carving in wood. In later years he used wood for some of his work and also has employed granite and marble extensively. A number of large fountains in his native land are compound structures of metal and stone.

Vigor and boldness, exaggeration of some features at the expense of others, also a certain grotesque, whimsical humor seem to characterize all his work. This may be noted in particular in Fig. 8, a bull moose listening for the call. The same general features characterize the figure of the wild boar Fig. 7, apparently at peace with the world although conceivably thinking of an improved technique for ripping hunting dogs to ribbons. The title of the figure appropriately might be *Dynamite*—harmless if undisturbed!

Always, northern sea figures appear in Milles' fountains and other work of a like character. He favors sharks, seals, skates, narwhals, dog fish, unicorns, tritons with conger tails. This latter feature is shown in the various cast bronze figures illustrated in Figs. 1 and 3.

Fig. 4—The sea motif again is displayed on the large bronze bath

After three years in a technical school, Stockholm, Milles won a prize in 1897 and immediately set off to Paris where he lived and worked and studied in poverty for the following two years. He exhibited at the Salon in 1899 and was a devoted admirer and imitator of Rodin for a period of 10 years. Then his own individuality asserted itself and thereafter he followed his own creative impulse.

His Paris experience was followed by a period of study in Munich, Germany, where he was impressed by the sound principles of the great German Sculptor Adolph Hildebrandt. Later he traveled to Austria and Italy. He married an Austrian artist and eventually returned to his native land where he established himself in a home and grounds—one of the show places of Sweden—at Lidingo, an island suburb of Stockholm.

Fig. 5—Bronze figure based on the legend of Folke Filbyter

The city is in view directly across the sound. To the south the owner has a view of the turbulent Malaren river and the Baltic from which water is pumped for the swimming pools. Hildebrandt's villa in Italy probably suggested the idea for this northern home with its paved courts and sheltered loggia, its pillared terraces and variety of charming trees, its ponds and bubbling fountains, its outdoor swimming pools guarded and ornamented by grotesque sea creatures in marble, granite and bronze. The house sits high on a granite cliff, against a background of white sand and blue sky. It is a synthesis of his life's work and at the same time the most perfect setting for it. He plans to leave house, grounds and work of art to the city of Stockholm when he dies.

The heroic size horse and rider shown in Fig. 5 is a duplicate of the original, set up in the city of Linkoping, Sweden. It is the sculptor's conception of a legend or a scrap of folk lore connected with one of the early royal families. The rider is Folke Filbyter, tired and sick and old, weary of reigning, myopically seeking for his young son, heir to the throne, mysteriously kidnapped when an infant and never seen afterward.

According to accepted historical records, Sweden always has been partial to the monarchial form of government. However, that does not necessarily imply a partiality to any hereditary monarchial family. If any person was sufficiently curious to institute a comparison, he probably would find that the independent, hard headed and liberty loving Swedes have changed rulers more frequently than the inhabitants of any other country in Europe. They believe in having a king at the head of the government—but—the king must watch his step! Folke Filbyter of the royal family of Folhunge flourished about 1200 A. D.

In the absence of authentic photographs of the period one man's guess is as good as another's. In the event that the horse and rider are accurate portrayals, the modern spectator may be pardoned for reflecting that the 20th century horse is quite an improvement on the thirteenth century model. The chassis lacks the streamlines. The transmission is not equipped for free wheeling. Lack of a bridle or other form of steering apparatus (*Please turn to page* 56)

Fig. 6—The denizens of the forest. Fig. 7—Thinking of the days when he was a little pig and went to market. Fig. 8—The bull moose listens to the call of the wild

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the following advisory staff: Steel, John Howe Hall; Malleable, H. A. Schwartz; Gray Iron, John W. Polton; Nonferrous, N. K. B. Patch

Reduced Metal Demand Will Require a Smaller Blower

We have been operating a cupola lined to 50 inches in diameter with a capacity of 10 tons per hour. We are contemplating changing our conditions to melt 3 tons a day, and we would like to have your comments and suggestions. Also we have in mind some work which requires the melting of 1000-pound charges of alloy metal.

You do not state whether you want your 3 tons of iron melted at one time or over a long period of time. In any case while you could line your present cupola down to the desired diameter, it would be necessary to secure a blower much smaller than the one you now are using. Hence, it probably will be just as cheap to purchase or build a small cupola to fit your purpose, and then the large cupola always will be available for the heavier tonnages. Since we do not know whether you want to melt your 3 tons of metal at the rate of ½-ton per hour or at the rate of 3 tons per hour, we will give the approximate melting rates of several different sizes of small cupolas.

A cupola lined down to 18 inches will melt from ¼ to ½-ton of iron per hour while one lined to 23 inches will melt from ½ to 1-ton per hour. A 27-inch cupola will melt from 1 to 2 tons per hour and one 32 inches in diameter will melt from 3 to 5 tons per hour. As mentioned previously a blower of the proper size should be secured for the cupola as it will be a problem to slow the present one down to give the correct amount of air, and the cost of operation will not be any less than it is now.

Presumably the alloy you mention is a nonferrous one, and an open flame, oil-fired furnace or an electric furnace would be suitable. If it is alloy iron that you have in mind, it probably could be melted in the small cupola that is suggested for your gray iron.

Use Dry Sand Cores For Disk in Stainless Steel

Can you give us any information relative to the application of permanent molds for steel castings? We have been informed that some of this work is being done. The job we have in mind is a circular disk ⅜-inch thick and 12 inches in diameter, to be made from stainless steel containing 16 per cent chromium with carbon from 0.85 to 0.95 per cent. Can you recommend a gating method for this job in dry sand cores? What would be a good sand mix and core wash for such a job? We desire to obtain a smooth skin, and would like to try permanent molds if possible. We will appreciate any information on the material for the mold, gating, temperature of the mold when pouring, cooling of the mold, and preparation for protecting mold surface.

We know of no successful efforts to produce small castings of stainless steels in permanent molds. This is especially true when it is desired to obtain a smooth skin on the castings. When heavy pieces like ingots are poured in iron molds, it is possible to secure a fairly smooth surface, but light parts poured against metal molds generally have irregular wavy marks like shallow laps or cold shuts all over the surface.

In working to secure a smooth skin on stainless castings, nearly all foundries are using fine silica sands averaging from 80 to 100 mesh or even finer, bonded with the minimum practical amount of clay, silica flour, and binders. The molds are made either in dry sand, or in green sand deeply skin dried just before pouring, which practically amounts to the same thing as dry sand.

Small jobs such as those under discussion generally are made in dry sand cores. For such a job as that described we would recommend that the piece be poured standing on edge, gated at or near the bottom, and with one or more pop-gates taken off at the top, to carry off any traces of dirt and to let the air escape from the mold as it is filled. This pop-gate, or small

head at the top, should be of sufficient cross section to allow the free escape of air so that the steel may fill the mold as fast as it can be poured down the gate.

No special precautions need be taken with the temperature of the mold, but the steel to pour such a job should be of a high temperature. The castings should, if possible, be shaken down out of the mold red hot, transferred to a hot furnace, and cooled down with the furnace to avoid cracking and tearing.

When a fine sand is used for the mold it is not necessary to cover the surface with a wash, but spraying with oil before drying will be satisfactory. However, if preferred, the molds may be coated with a wash of silica flour, such as is used in any ordinary dry sand steel foundry practice.

Instead of gating at the bottom, this casting could also be poured on edge by making a head at the top about ¾ x 2 inches and some 6 inches high, and pouring straight down this head into the casting. This will require a good hard sand at the point where the stream strikes, and probably the use of several nails in the sand at that point to prevent cutting by the falling stream of metal.

Shrinkage Shows on Aluminum Casting Surfaces

We are making molds for the manufacture of paper mache display figures. The molds are made of aluminum and we seem to be having a lot of trouble with excessive shrinkage on the surfaces that make the mold proper. Similar castings made elsewhere appear smooth and show no signs of shrinkage. We would like to know if something else beside sand is being used in the manufacture of castings of this type, or if there has been any development in molding practice that will eliminate our trouble. Castings are life size figures and weigh in sets, from 35 to 40 pounds for the lightest to about 90 pounds for the heaviest. We have tried chilling to prevent the surface shrinkage without much success.

You do not state the aluminum alloy you are using, but we presume this is the standard No. 12, containing 92 per cent aluminum, 8 per cent copper. This has the lowest shrinkage of the high aluminum alloys, but is affected in its shrinkage by the temperature at which it is poured. It is, therefore, advisable to gate such castings as you describe so that the metal enters a large number of points and thus enables the casting to be poured at the lowest possible temperature. This is determined, of course, by experiment.

We do not know of any other method than that of sand molding such castings as these and we believe your trouble lies largely in overheating the metal in the furnace. It is important not to raise the temperature of the metal beyond that at which it should be poured and it is equally important to pour at the lowest temperature which the mold will fill completely. If this does not correct your difficulty, it may be advisable to locate chills on the back of the castings at such points as still give trouble from shrinkage. As in all nonferrous alloys which shrink, shrinkage can be corrected by the presence of feeders or risers; but it is frequently difficult to provide the necessary risers at their proper location and chills then are substituted. However, the process of chilling is a delicate one and should not be resorted to unless no other solution of the problem is available. Try carefully melting your metal at just the right temperature and pouring immediately, gating the castings so that the lowest possible temperature can be used.

Prepare to Make Gray Iron Air Cooled Cylinders

We shall appreciate any information you can give us on proper core sand mixtures, metal, gating, etc., for air cooled cylinders.

Methods, materials and equipment vary to a considerable extent, depending on the size, shape and type of air cooled cylinder. For example the entire assembly, mold and cores for a motorcycle cylinder, is made in core sand. The mold for a compressed air locomotive cylinder is made in dry sand. The width of the space and the depth between the vanes is the deciding

Visions of the past-Eighteen years of improvement has incorporated more die castings in the machine, but the older one still functions completely

factor on which material to use. Manifestly where the vanes are close and deep, an extremely rigid and permeable material is required.

Core materials, metal and gating methods conform to standardized automobile casting practice. Where the casting is designed to be poured in a vertical position, the metal from the pouring basin flows down through a number of small pop gates around the top of the barrel. Where the casting is molded in a horizontal position the metal flows through a strainer core at the bottom of the sprue into a long runner which delivers the metal through a number of small shallow gates located near the bottom of the mold.

Carbon Content of Steel Easily Increased

We are making steel castings from metal blown in a side-blown converter, and the steel usually comes out with 0.3 to 0.4 per cent carbon. From time to time we are called upon to make gear wheels with a carbon content of 0.5 to 0.6 per cent. How can we make them without devoting a heat entirely to higher carbon metal?

To make steel containing 0.50 to 0.60 per cent carbon from a steel containing 0.30 to 0.40 per cent carbon, it is only necessary to add sufficient carbon-containing material to raise the carbon percentage to the desired amount. The best material to use is the metal tapped from the cupola, which contains about 3.5 per cent carbon.

For instance, if 500 pounds of steel is required with a higher carbon content, the pounds of carbon which must be added is 500 multiplied by 0.002, or one pound. As the cupola metal contains 3.5 per cent carbon, the amount of cupola metal required is 1 divided by 0.035, or approximately 30 pounds.

The simplest procedure is to put the 30 pounds of melted iron from the cupola into a 500-pound shank ladle, and then add 475 pounds of the 0.30 to 0.40 per cent carbon metal from the big ladle. The ordinary procedure would be to take the iron from the next following heat, and in many shops the amount desired is measured in a small hand ladle rather than weighing it each time. Ladles are available which hold, for instance, 60 pounds, and these are filled half full to measure out 30 pounds. In the same way it often is determined by experiment that an available ladle will hold, for instance, 750 pounds of steel, and if this is two-third's full there are 500 pounds in it.

There will be a small increase in the silicon and manganese of the small lot of higher carbon steel, due to silicon and manganese in the melted iron, but this will not be sufficient to be harmful.

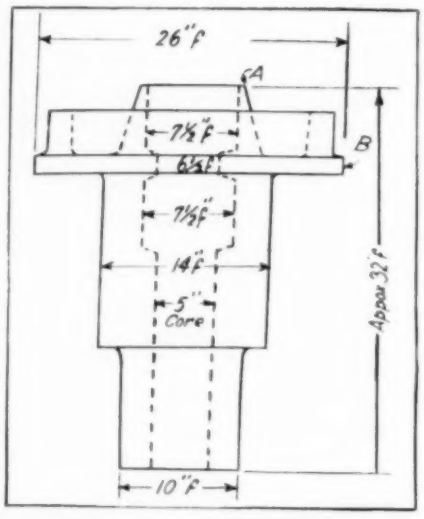
Another way of accomplishing the same object is to put powdered coke or fine hard coal in the smaller ladle, and pour the steel on top of it. However, that method, is far less reliable than the use of melted cupola metal because it is difficult to predict just how much of the carbon in the coke or hard coal will be absorbed by the steel. Generally, if the coke is assumed to be 50 per cent carbon, the analysis secured will be within the desired limits.

Cracks Appear in Hub of Steel Castings

After working over a year on various roll head castings, similar to the attached sketch, we still experience both horizontal and perpendicular cracks on the outside diameter of the long hub of this casting. Sometimes these cracks, which are all fine, appear near the open end of the roll and sometimes further up near the flange. This same condition has been and is being continually experienced by other foundries in this section on a similar casting.

It would have assisted greatly in arriving at an explanation of the trouble experienced with your roll head castings if you would have given certain details, including whether these castings are poured in green sand or in dry sand, the composition of the steel of which they are poured, and whether the castings are allowed to cool in the mold, whether they are shaken out hot and cooled in the air, or whether they are handled after pouring in some other manner.

The concensus of opinion of foundrymen to whom the sketch has been shown is that the castings should be poured on end with the flange down. A head should be used covering the entire end of the hub, and about 12 inches to 15 inches high. This may either be a solid 10-inch head, or the center core may be extended through it, but not over 3 inches in diameter, so that the head would have walls 3½ inches thick.



The roll head casting has longitudinal cracks in the hub

It is believed that the gate should be carried down, and cut into the side of the flange or led to the extreme bottom at the point which is marked *A*, by a horn gate. However, it would be preferable to gate at point *B*.

Experience would indicate that to avoid the formation of cracks this casting should be shaken out of the mold while it is still at a bright red heat. The core, if possible, should be broken up with bars, and the castings, while still at a bright red heat, transferred to a hot annealing furnace, heated carefully to about 1600 or 1650 degrees Fahr. for several hours and cooled slowly in the furnace.

The recommendation that these castings be transferred hot to an annealing furnace is based on the assumption that the composition of the steel is that of ordinary commercial cast steel.

Gives Analyses For Railroad Bronzes

Can you give us any information on making brass bushings in iron molds? Also, can car journal brasses be cast in molds? Have you any information on the analyses of locomotive rod and crown brasses?

The subject of casting brass bushings and railroad bronzes in iron molds was treated comprehensively in two articles by Henri Marius which appeared in the Aug. 15, 1929 and Jan. 1, 1930 issues of THE FOUNDRY. The respective titles of the articles are "Brass Is Cast Successfully in Permanent Molds" and "Railroad Bronzes Are Cast in Permanent Molds."

According to the specifications of the American Society for Testing Materials, hard bronze containing 10 to 15 per cent lead; 7 to 10 per cent tin; 1.25 per cent zinc, maximum, and remainder copper, is used for connecting rod bearings, valve motion bushings, crosshead gibs and miscellaneous bearings subject to hard wear and also for pedestal wedges and eccentric straps. For driving box brasses, engine truck brasses, hub liners, and bearings which require lining metal for facing or lining a medium bronze is specified. It contains from 14 to 22 per cent lead; 6 to 8 per cent tin; 1.25 per cent zinc, and remainder copper. Medium bronze also is used for chilled castings.

Viewing Foundry Developments

At Short Range

A CAST iron which is cast centrifugally and is suitable for hardening by the nitrogen-hardening process, owes its susceptibility to the treatment to the presence of aluminum and chromium in the metal. A typical chemical composition is as follows: Total carbon 2.75 per cent, silicon, 2.75 per cent, manganese 0.75 per cent, phosphorus 0.10 per cent, aluminum 1.75 per cent and chromium 1.75 per cent. Exposed to anhydrous ammonia gas at a temperature of 500 degrees Cent. under conditions of the process, a surface hardening with a diamond hardness of 982 is obtained. A depth of penetration of 0.018 inches was obtained in a centrifugally cast specimen with a 90 hour treatment under standard conditions.

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A radiator for either steam or hot water systems, which is cast in one piece and is provided with a humidifying trough in the hottest part of the radiator, is said to contain many advantages. The unit may be installed in the room, or built into the wall or cabinet.

• • •

STEEL castings containing 3 per cent chromium are beinu gsed increasingly for machine parts in which wear resistance is required, such as the jaw plates on a rock crusher.

• • •

Less than a millionth of an ounce of iron can be determined quantitatively by a method employed in the General Electric research laboratory. The metal is converted into ferric thiocyanate, a solution whose redness depends on the amount of iron dissolved. Ordinarily the redness is determined visually, but more accurate measurements have been made possible by use of the recording color analyzer developed in the general engineering laboratory of the company.

• • •

Improved physical properties of zinc die casting alloys on the market have increased the use of that engineering material in many instances. For example, many effects secured on the present model of automobile are secured through the use of die castings. Impact strength has been improved in the zinc base die castings and tensile strength likewise has been increased, in some instances to as high as 50,000 pounds per square inch.

• • •

OBTAINING sound castings in certain brasses which must resist high pressures is a matter that requires considerable experience. That is amply illustrated by a manganese bronze pump head casting which only weighed 40 pounds but necessitated a 300-pound riser to obtain the required denseness of structure. The order specified that the casting be made solid, and it later was bored and drilled for the necessary passages. The machined casting then was subjected to a 5000-pound per square inch pressure test without any leaks showing.

• • •

Photoelectric lighting control relays are becoming popular as a means of controlling the illumination in offices and factory aisles, and experience with such applications indicates that frequently considerable savings in power consumption as well as increased production can be obtained through the application of the device.

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The 1933 Dodge cars have the motor block, manifold and exhaust pipe covered with a new aluminum coating, the product of Aluminum Industries Inc., Cincinnati. The coating has advantages in withstanding heat, as was shown in 200 hour tests during which manifolds reached a temperature of 1400 degrees.

• • •

A cast iron of the following analysis has been found exceedingly satisfactory for melting pots for aluminum: Total carbon, 3.00 to 3.30 per cent; silicon, 1.00 to 1.20 per cent, nickel, 1.50 to 2.00 per cent; and chromium, 0.70 to 0.80 per cent. The material is thermally stable and shows a fair degree of growth resistance at temperatures up to 1200 degrees Fahr.

• • •

CUPOLA metal for pouring large high test castings may be treated with up to 30 pounds of fused sodium carbonate or more per ton of metal with the reduction of sulphur to under 0.04 per cent in the finished casting.

• • •

Addition of nitrogen to steel of low carbon content increases the tensile strength, the elastic limit and the brinell hardness, but lowers the reduction of area and the elongation, according to recent tests.

• • •

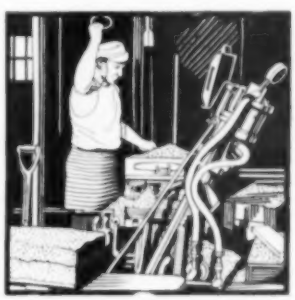
Tests have shown that cast iron borings can be melted in the open-hearth furnace providing they are protected properly before and after melting with slag and small coke.

• • •

Molasses water, often sprayed on the face of green sand molds to prevent the cutting action of the iron, usually is used in the proportion of 1 to 15 and 1 to 30.

• • •

With the advent of beryllium-copper alloys into the nonferrous foundries, especial care must be taken to see that those alloys are



segregated from the remainder of the red alloys as it has been found that small amounts of beryllium have an extremely detrimental effect on the regular red alloys.

The FOUNDRY Family Photograph Album

Photo Bachrach

Upper Left

C. H. CHAMPLAIN

Westinghouse Electric & Mfg. Co. East Pittsburgh, Pa.

Upper Right

R. L. COLLIER

Steel Founders' Society of America, New York

Lower Left

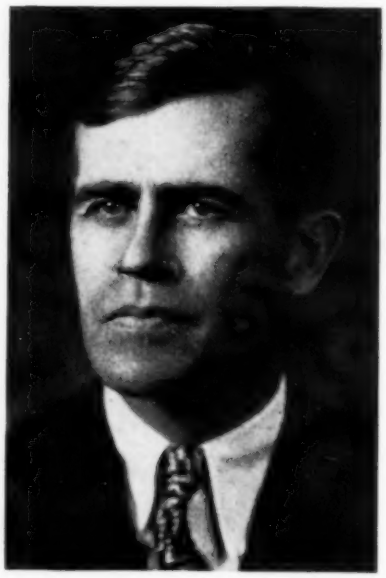
C. R. RICHARDS

Lehigh University, Bethlehem, Pa.

Lower Right

E. P. CONNELL

Falk Corp., Milwaukee



Men of Industry

Whose Activities Are Making Foundry History

EDWARD P. CONNELL, (see Family Album, opposite page) has been appointed vice president of the Falk Corp., Milwaukee. Mr. Connell is a native of Marquette, Mich., and became connected with the Falk Corp. following a brief business career with the Lake Shore Engine Works, Marquette. His progress in the Falk Corp. was through the accounting and purchasing departments of the business and in 1924 he was appointed comptroller of the corporation. Since then his duties have been extended to both selling and production so that now he is active in virtually all departments of the company. Mr. Connell also is treasurer of the Claybourn Process Corp., manufacturer of printing presses and plate making equipment and has been active in the work of the American Gear Manufacturers association.

DR. O. N. GREEN recently was elected president of the Newton Foundry Co., Newton, Iowa. George O. Nelson was named vice president and F. J. Kelly was re-elected secretary and treasurer.

CHARLES L. GILBERT has been elected vice president and treasurer, Scullin Steel Co., St. Louis, succeeding the late V. C. TURNER. EDWARD F. JUDGE has been elected assistant treasurer and will continue in conjunction with his duties as secretary of the company.

C. H. CHAMPLAIN (see Family Album, opposite page) recently was appointed general works manager of the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., and will supervise the management and operation of all plants of the Westinghouse company. Mr. Champlain became connected with the Westinghouse company in 1898, and a few months later was made assistant foreman. In 1903 he was made general foreman in charge of manufacture of industrial and railway motors and for 12 years had charge of various divisions of the works devoted to the manufacture of electrical equipment. In 1915 he was placed in charge of munitions manufacture and later was transferred to East Springfield, Mass. where he was appointed general superintendent of that works. In 1919 he returned to East Pittsburgh as assistant works manager. Four years later he was sent to Sharon, Pa., where he built and organized a factory for the manufacture of transformers. After 8 years at Sharon he again was transferred to East Pittsburgh where he was made works manager, and occupied that position for two years.

H. F. SEIFERT, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed general superintendent of the foundry and micarta products division of the company at Trafford City, Pa.

WILLIAM LAIRD is now foreman of the brass foundry at the Linhart works of the company.

DAVID C. GRIGGS was re-elected president of the Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn., at its recent annual meeting. Other officers include R. L. WILCOX, and Z. P. CANDEE, vice president; W. D. PIERPONT, secretary; L. S. REED, treasurer; directors, E. A. ANDERSON, D. C. PIERSON, G. R. LAMB, W. S. FULTON and the above elected officers.

T. I. PHILLIPS has been appointed works manager of the East Pittsburgh Works., Westinghouse Electric & Mfg. Co. Mr. Phillips formerly was works manager of the Nuttall plant of the company, and in addition to new duties of factory management and operations, remains in charge of that plant in a supervisory capacity. W. OSWALD has been appointed superintendent of the Nuttall plant.

HORACE J. YOUNG, recently appointed to take charge of the foundry and research department of Hepworth & Grandage Ltd., St. John's Works, Bradford, England, also has been appointed a director. For a number of years Mr. Young was chief metallurgist to the North Eastern Marine Engineering Co. Ltd., Wallsen-On-Tyne and Sunderland. Prior to joining Hepworth & Grandage Ltd., he was engaged in private consulting practice in London. He is well known in foundry and scientific circles and is the author of numerous papers on cast iron and foundry practice.

DR. CHARLES RUSS RICHARDS, (see Family Album, opposite page) president, Lehigh University, Bethlehem, Pa., recently was appointed a member of the main research committee of the American Society of Mechanical Engineers, by President A. A. Potter. Previous to Dr. Richards' installation as president of Lehigh University in 1922, he was dean of the college of engineering and director of the engineering experiment station at the University of Illinois, Urbana, Ill.

O. L. HOLLISTER was re-elected president-treasurer of the Federal Malleable Co., West Allis, Milwaukee, at the recent annual meeting. WILLIAM A. DRAVES was elected vice president in place of C. R. MESSENGER, and WILLIAM J. MACNEILL, secretary in place of L. S. PEREGOY. Messrs MESSENGER and PEREGOY and E. L. WOOD and WILLIAM C. FRYE were re-elected directors. Newly elected directors are ALBERT W. DRAVES and LINUS KREBS.

RAYMOND L. COLLIER, (see Family Album, opposite page) for several years assistant managing director Steel Founders' Society of America, New York, recently was appointed managing director of that organization suceeding GRANVILLE P. ROGERS who has resigned to become affiliated with the Paper Cup Manufacturers institute, New York. After graduating from Ohio State university, Columbus, O., Mr. Collier was assistant yard foreman and later in charge of the automotive brush department, National Carbon Co., Cleveland. In 1924 he became connected with the test department of the Cleveland Electric Illuminating Co., where he was engaged in special research work. In

1926 he was transferred to the sales department of the same company. Later in the same year he became assistant to the managing director, Artistic Lighting Equipment association, and in 1929, was made assistant managing director of the Steel Founders' Society of America.

^ ^ ^

GEORGE W. FULLER, consulting engineer, Fuller & McClintock, New York, has been elected chairman of the Engineering Foundation. HARRY P. CHARLESWORTH, vice president, Bell Telephone Laboratories, New York, was elected first vice president and H. C. BELLINGER, vice president, Chile Exploration Co., New York, was chosen second vice president.

^ ^ ^

FRANK S. O'NEIL, assistant plant manager, Link-Belt Co., Indianapolis, has been re-elected president of the Foundrymen's Association of Indianapolis. GUY E. STREET, superintendent of the American Foundry Co., was re-elected vice president, and HENRY W. BLISS, manager and secretary-treasurer of the Sinker-Davis Co., was re-elected treasurer. ANDREW J. ALLEN, is secretary.

^ ^ ^

DR. VSEVOLOD N. KRIVOBOK, professor of metallurgy, Carnegie Institute of Technology, Pittsburgh, will deliver the Campbell Memorial lecture during the 1934 annual convention of the American Society for Steel Treating. Dr. Krivobok has been connected with the Carnegie Institute of Technology for the past 8 years and as a member of the research staff of the bureau of metallurgical research, has worked principally with stainless and heat-resisting steels.

Welds Thumb on Iron Statue of Vulcan

Several years ago THE FOUNDRY presented a series of articles by Pat Dwyer on the cast iron pipe industry in the Alabama district. One of the articles included an interesting illustration and description of a cast iron statue of Vulcan, located in the Birmingham Fair Grounds. Recently it was necessary to repair the statue, the welding process being employed for the work.

The October issue of *Welding* presents an interesting description of that job in an article entitled "Job Welding Shop's Place in the Industry," by E. H. Brown, Birmingham Welding Co., Birmingham. Mr. Brown refers to that work as follows:

"Probably the most unusual outside job we were ever called upon to perform was the replacement by welding of a thumb on a hand of Vulcan, who stands at the Fair Grounds. It will be recalled that this large cast iron figure was exhibited at the St. Louis World's Fair in 1904 as a symbol of Birmingham's iron industry. The figure is 50 feet high and weighs altogether 120,000 pounds. The thumb which weighed about 300 pounds came loose from the bracket by which it was held and fell to the ground. Since it was felt that it might be a hazard if

Considerable preparation was necessary to put a new thumb on this 50-foot statue

it were replaced and secured by the former method, it was decided to substitute lighter material.

"After a good deal of thought, copper sheet was chosen as the metal for the new thumb which was to be hollow and welding was decided upon for all seams and for joining the thumb to the cast iron hand. The copper sections of the thumb were formed on the outside of the old thumb and then these were gas welded together with bronze rod to form a sort of tube closed at one end, approximately 30 inches long and about 16 inches in diameter.

"As can be seen in the accompanying illustration a scaffold was erected to reach the thumb and with welding gases supplied through long hose lines from oxygen and acetylene cylinders in the roadster below, the thumb was bronze-welded to the cast iron hand with little difficulty. Somewhat more than ordinary skill was required of course, because the welding was done in position and there was considerable difference in thickness between the copper shell and the heavy cast iron hand."

Institute Plans Annual Meeting Program

The annual meeting of the Gray Iron institute will be held at the Cleveland hotel, Cleveland, on Wednesday, March 22, according to a recent announcement of Arthur J. Tuscany, manager.

The following program has been arranged for the meeting:

MORNING SESSION

8:30 a.m.—Registration-Visitation-Committee Meetings.

9:30 a. m.—Call to order.

Reports of officers:
- A. E. Hageboeck, president.
- R. D. Phelps, treasurer.
- Arthur J. Tuscany, manager.

Reports of Committees:
- Finance and Budget, H. S. Chafee, chairman.
- Membership, Ray Redmond, chairman.
- Nominating, Earl H. Thompson, chairman.

10:30 a.m.—Cost Session:
- "Progress in Cost Activities" by John L. Carter, vice president.
- "Importance of Classified Molding Costs" by Charles A. Klaus, Eastern cost consultant.
- "The Why of Industry Standards" by P. E. Rentschler.
- "Relation of Uniform Costing to Profits of Individual Members" by A. C. Denison.

Discussion.

12:00 noon—Group luncheon.

AFTERNOON SESSION

1:30 p. m.—Technical Session.
- "The Forward March of Gray Iron" by J. D. Coltman.
- "Specifications for Gray Iron Castings A48-32T"
  - (a) "Founder's Viewpoint," by A. C. Ziebell.
  - (b) "Buyer's Viewpoint," by W. W. MacMillen, chairman, Iron & Steel Committee, National association of Purchasing agents.
- "Properties of Gray Iron for Light Structures Analyzed." Report of the light gray iron subcommittee by E. B. Sherwin.
- Round Table on Control, Technical Sales Problems, and Allied Subjects.
  - (a) Encroachment of Competitive Materials.
  - (b) Proper Application of the Different Classes of Gray Iron Within the Industry.
  - (c) Engineering Aspects of Gray Iron Structures.
  - (d) Foundry Test Standards.

4:00 p.m.—Merchandising Session.
- "Gray Iron's Opportunity" by C. B. Magrath.
- "Our Company's Viewpoint on Marketing" by Past President Walter L. Seelbach.
- "How We Cashed in on a Sales Plan" by John Diedrich.
- "New Uses for Gray Iron—Development—Application" by Arthur J. Tuscany.

Discussion.

4:30 p.m. "The Gray Iron Institute Fire Insurance Plan" by William J. Grede.

"Speaking as a Subscriber" by J. H. Bruce. Discussion.

Robert D. Black recently was appointed sales manager of the Black & Decker Mfg. Co., Townsend, Md.

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE—*Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Digging Own Grave

To the Editors:

I wish to thank you for sending me the clipping covering price classifications for malleable by an anonymous malleable manufacturer. This article had already come to my attention.

Our own feeling here as producers not only of malleable, but several specialized foundry products, is that each classification of metal as well as each weight and production quantity of castings should be considered in arriving at a fair price. Some of our products we sell strictly to an established price schedule, which we publish and send out to our customers. On other types of casting we make use of a cost estimating schedule set-up on the basis of average costs covering a large number of jobs which have run through the foundry in the past. Other prices are determined by actual studies of jobs on which we receive an inquiry.

We are firmly of the opinion that a foundryman is digging his own grave when he disregards his costs to meet market conditions and every price quoted by our company would show a profit with a reasonable rate of operation (considerably less than normal).

D. P. FORBES.

Gunite Foundries Corp.
Rockford, Ill.

Favors Schedule

To the Editors:

I have read the article by the "Malleable Manufacturer" which you have headed "Proposes Classification As Yardstick of Values." The principles expressed by this correspondent, in my opinion, are sound. There is no doubt that when the factors of quantity to be made, weight of flasks, weight of molds, proportion of cores, and type of equipment are taken into consideration a surprisingly accurate schedule of cost can be developed. On the average cost developed in this way after careful study would be more accurate than that arrived at through the usual estimating process, and with practical judgment in each instance it would have a tendency to avoid the great errors that are frequently the result of individual detail building up of an estimated cost.

In quoting on inquiries that have been sent out to a large number of companies there is usually somebody, through error or misunderstanding, extremely low on each item figures. A properly prepared schedule of average costs would almost entirely eliminate this problem on the part of those who use the schedule.

EX-MALLEABLE MAN.

Memorial
To Charles Vickers

By John Duffy

I walked along the crowded street,
Amid the tramp of many feet,
Three words my heart seemed to repeat,
Vickers is dead.

I dreamed of standing by his bier,
My soul was seized in nameless fear,
All future plans were cold and drear.
Vickers is dead.

The foundry now was bleak and cold,
The furnace, metal, and the mold,
Hushed and idle, the story told,
Vickers is dead.

Lo! Pondering, there comes a thought,
Has this great life then been for naught?
What of the countless works he wrought?
Is Vickers dead?

The deeds he'd done, the words he'd spoken,
A chain of service never broken,
Question Eternity by their token,
Is Vickers dead?

The corpse they bore to Forest Lawn
Awaits the call of immortal dawn,
Remains but the clay, the spirit's gone,
Vickers lives on.

The work he did, the miles he traveled,
The foundry problems he'd unravelled,
He never shirked nor ever cavilled,
Vickers lives on.

His friendly air, his cheery smile,
His handclasp that made all worth while
And cheered us on life's weary mile,
Vickers lives on.

I walked along the crowded street,
I heard the tread of many feet
My heart still sang a song so sweet,
Vicker lives on.

EDITOR'S NOTE: Mr. Duffy, a life-long friend of Mr. Vickers, is a practical foundryman identified with nonferrous work for many years.

Chicago Founders Hear Talk by E. O. Jones

Good foundry housekeeping, with special reference to its effect on the dust hazard, occupied the attention of about 100 foundrymen who attended the monthly meeting of the Chicago Foundrymen's club at the Great Northern hotel, Chicago, March 2. E. O. Jones, Belle City Malleable Iron Co., Racine, Wis., who has been prominent in activities of Wisconsin foundries in combating this problem, was the principal speaker. J. R. Allan, International Harvester Co., acted as guest chairman of the meeting, with Gottfried Olson, president of the club, presiding.

Mr. Jones described the efforts of foundries of that state in opposing the adoption by the industrial commission of an unworkable code covering dust, fumes, vapors, and gases in connection with occupational diseases, as well as a discussion of measures taken to eliminate dust in plants. A detailed report by Mr. Jones on this work was published in the January issue of THE FOUNDRY. Other speakers who relater experiences with the problem were Dr. J. A. Britten, International Harvester Co., and Dr. A. M. Harvey, Crane Co. The former stated that the dust hazard in foundries, according to records of the company, is not a contributor to the spread of tuberculosis, the percentage of foundry workers so afflicted being less than that of all plant employes.

Control Is Practical

A number of recommendations were given by various speakers for the control and elimination of fine dust particles, particular emphasis being given to the necessity for regular inspection of ventilators, dust arresters and helmets and the removal of dust accumulations from rafters and other projections.

Assuming there may be definite hazard inherent in foundry work from the presence of dust particles, it was the opinion in general discussion on the subject that adequate compensation should be provided workers afflicted with diseases definitely traceable to such causes, but that this situation should be met in the state through an occupational disease act whereby disablement would be treated in the manner provided for accidents rather than expose the foundry industry to common law suits involving exorbitant sums of money.

A committee of foundry operators has bees appointed by the Illinois Manufacturers' association to prepare recommendations for such an act, but certain other industries so far have expressed unwillingness to support a measure of this nature. Further attempts will be made to seek protection for foundries of the state through legislative action.

High test iron will be the principal subject for discussion at the April 6 meeting of the Chicago club.

Figuring Melting Cost of Iron

An error in computing that factor often means difference betueen profit and loss

By J. J. ROWBOTTOM
Diversey Foundry Co., Geneva, Ill.

IN VIEW of the accepted method of treating the cost of iron as a separate component when figuring castings costs, a thorough knowledge of that cost becomes necessary. An error in that factor generally means the difference between a profit and a loss and the subject should be carefully analyzed. The following items, summarized, make the cost:

1. Raw materials, plus freight or cartage.
2. Raw materials, unloading.
3. Labor, transferring to charging floor, makeup of charges, placement in cupola.
4. Labor, preparation of cupola, tapping out, and conveyance of iron to molder floors.
5. Cupola supplies, brick, fireclay, etc.
6. Power.
7. Share of general overhead.
8. Losses in melting and handling.

Portray Variations

The variation between cost of raw materials only and total cost is best displayed by a practical problem.

Using the following prices:

No. 2 Northern	$16.00	Gross ton
No. 1 Cast scrap	6.00	Net ton
Coke	9.00	Net ton

A representative mixture would be

400	Pounds pig @ $0.70 per 100 pounds	$2.80
300	Pounds cast scrap @ $0.30 per 100 pounds	0.90
300	Pounds return @ $0.30 per 100 pounds	0.90
100	Pounds coke @ $0.45 per 100 pounds	0.45
50	Pounds bed coke @ $0.45 per 100 pounds	0.30
		$5.28
600	Pounds castings shipped	
300	Pounds allowed for returns @ $0.30	0.90
		$4.38
	Cost per 100 pounds of castings	$0.73

Purpose of this example items 3 to 6, inclusive, referred to in the second paragraph amount to 28 cents per 100 pounds in the iron melted. Corrected to basis of castings shipped equals 10 times 28 equals 47 cents.

Share of general overhead plus depreciation is indicated in item 7. Depreciation is figured on all equipment of the melting department. Share of general overhead is based on payroll comparison. For the purpose of this example a figure approximating 10 per cent of the total general overhead charges is used. This figure is 5 cents a hundred pounds for iron at the spout. Since 1000 pounds of iron are melted in this example, and 600 pounds of castings are shipped, a calculation will show the overhead charges for each 100 pounds of castings shipped is 8 cents.

Item 8 eliminates itself by conversion of melted cost to cost of iron in the castings. Summarized, we have:

Items 1 and 2—Cost of raw material	$0.73
Items 3 to 6—Conversion cost	0.47
Item 7—Share of general overhead	0.08
Total per 100 pounds	$1.28

In this example 50 pounds of bed coke is shown per 100 pounds melted and a ratio of 1 pound of coke to 6.6 pounds of iron melted from which it may be inferred that the total pounds melted would be moderate. Many heats at this time are so small that large cupolas do not equal the ratio given. With the production of a normal tonnage items 3 to 6 will scale down. With subnormal production, and small cupolas, perhaps operated daily, items 3 to 6 will be increased due principally to items 3 and 4.

A remelt is shown of 300 pounds return, 30 per cent of melt, coupled with the production of 600 pounds of good castings, 60 per cent of melt. The difference 100 pounds, 10 per cent of melt, is accounted for by losses in handling and melting. This melting loss, due to oxidation, handling, and other causes, is a debatable quantity, and while it may be stated safely to be always at least 5 per cent of melt, it will be in excess of that figure according to the variables of shop management. Slopping from ladies (shot iron), and loss in cupola drop are the greatest losses. Some apparent losses do not exist being due to inaccurate scales in the yard or charging room and it is not unusual to find errors of 5 to 10 per cent.

A cost is used of 28 cents a hundred pounds of iron melted and this appears as 47 cents per 100 pounds of castings. Herein lies the opportunity of affecting a considerable saving by ensuring that there is no needless pigging of iron and that undue amounts are not used in sprues, risers and pouring basins. Cold iron, use of iron to dry out ladles, and unnecessary pigging by the men pouring can account for considerable extra cost.

Return iron is priced in accord with common practice at the cost of purchased scrap. While it has a greater value common sense dictates the wisdom of allowing a small sum for variations not readily determinable in the total cost.

These figures apply only on costs where the ratio on return of iron melted is similar, as shown in the example. Where the yield of good castings differs from this ratio there will, necessarily be an increase or decrease. This factor must be taken into consideration when using this schedule.

Appoint New Sales Representatives

Norton Co., Worcester, Mass., has appointed Crane-Schiefer, Owens, Inc., with offices at Buffalo, Syracuse and Rochester, N. Y., as sales representative of its line of grinding lapping and balancing machines. C. H. Hill, associated with the sale and demonstration of Norton machines in that territory for many years now is connected with Crane-Schiefer, Owens, Inc. Buffalo office is at 210 Morgan building, Pearl and Niagara streets, Buffalo, the Rochester office at 425 Powers building, 16 Main street, West, Rochester, and the Syracuse office at 1602 State Tower building, Syracuse.

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Prevent Losses with

Proper Gates and Risers

By PAT DWYER

DISCUSSING the use of deoxidizers in the production of copper castings a writer has pointed out that while the drossing effect of small amounts of silicon in copper castings is not to be compared with the similar action produced by aluminum in nonferrous alloys, it is sufficiently serious to require precautions against its formation and entry into molds. Thus if a deep mold should be gated at the top so that the metal dropped and splashed when filling it, dross would be formed by the breaking of the surface films, which are formed instantaneously and coat the falling stream of metal as well as each little splash and drop that broke away.

When the film enveloped stream of metal breaks apart, the liquid interior flows out, leaving behind a husk of film. These husks get squeezed against the sides of the mold. When the casting is uncovered it is generally found that they have formed as laminations and can be picked away with a knife blade in the form of slivers. This form of dross renders it impossible to machine the surface of the casting and get down to good, clean metal without taking off too much stock. Consequently the casting has to be scrapped.

This form of trouble is prevented to a great extent by locating the gate at the lowest point of the mold, or bottom gating, in the foundry vernacular. The same precauions are required against undue agitation of the metal, caused by bounding back from the walls of the mold or core, and collision between entering streams, as are necessary with aluminum bronze and other aluminized alloys. In casting sticks, bushings, strips or other long pieces, it is advisable always to locate the gates in a position that will force the metal to climb upward and then flow into the riser.

This point is illustrated in Fig. 197, a sectional view of a heavy copper disk with gate and riser attached. In this instance the copper was deoxidized with 1.00 per cent silicon. This caused a certain amount of drossing in the metal, which in the casting was avoided by pouring the metal through a gate at the lower end of a tilted mold. The riser was located at a point diametrically opposite the gate and at the highest point in the mold.

When the molten metal entered the mold cavity, it formed a pool gradually increasing in size as the metal continued to flow. Without causing any particular commotion, the metal filled the riser to the level of the sprue head.

Use Hot Metal

It will be noted at this stage a considerable portion of the riser necessarily is empty. If the riser is to fulfill the function for which it is intended, solidification must be retarded until the metal in the casting has set. Without exception the metal in a riser must remain fluid for a greater length of time than the metal in the casting. Otherwise it is worthless and represents a waste of metal.

Properly deoxidized copper shrinks heavily and if the casting shown in the illustration was not fed liquid metal to fill the shrinkage voids, the central part of the casting would show a *pappy* condition on the inside and a depression or shrink on the top. The riser at the highest point was designed to prevent this condition.

Metal entering the riser from the bottom cannot be expected to show the same temperature and fluidity as fresh metal from the pot. Therefore it is heated by pouring metal from the crucible directly into the riser. To prevent the back pressure from driving the metal out through the sprue at a lower level, the metal in the sprue is cooled with water, or, it is covered with sand held down with a suitable weight.

Preferably, metal that is poured into the riser should be hotter than metal poured into the casting. Also, it should be poured slowly so that to a certain extent it may keep pace with the solidification of the casting. In many instances it is advisable to begin pouring metal into the riser before the sprue is covered to insure an open channel of communication between the riser and the heart of the casting.

Extensive dissertion on the effects of deoxidizing materials on copper castings lies outside the scope of the present series of articles. Readers interested in the subject will find it covered comprehensively in an article by the late Charles Vickers "Deoxidizers Should Be Used Discreetly," which appeared in the Oct. 15, 1928 issue of THE FOUNDRY.

Method adopted for pouring and feeding copper castings is illustrated in Fig. 198. These castings were molded in pairs as bushings and afterward cut into rings and therefore had to be absolutely solid and homogenous. Their production involved a high degree of skill on the part of the foundryman, both in making the mold and in melting the met-

(*Continued on page 40*)

Copper Shrinks

ONLY a comparatively few years ago the average foundryman held to the belief that it was impossible to secure a really sound copper casting. Some inherently vicious factor produced shrink holes and blow holes. In recent years that belief has been dispelled. Copper castings perfect in every detail are produced in large quantities by men who are familiar with every detail of the necessary process. To those not similarly equipped, copper still presents the same baffling characteristics it presented to the men who first tried to produce solid castings. Method of gating the castings is one of the most important features, while the size and position of the feeders, particularly on heavy castings and castings of unequal section, is the most important feature of all. In addition to providing feeders of adequate size and shape, these feeders must be filled with hot metal to insure a liquid condition until after the metal has set in the adjoining part of the casting.

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J. L. Brooks Metallurgist

Sparta casts 56 perfect ¼-in. piston rings on one riser—a performance made possible by melting in cupolas equipped with Griffin Hot-Blast

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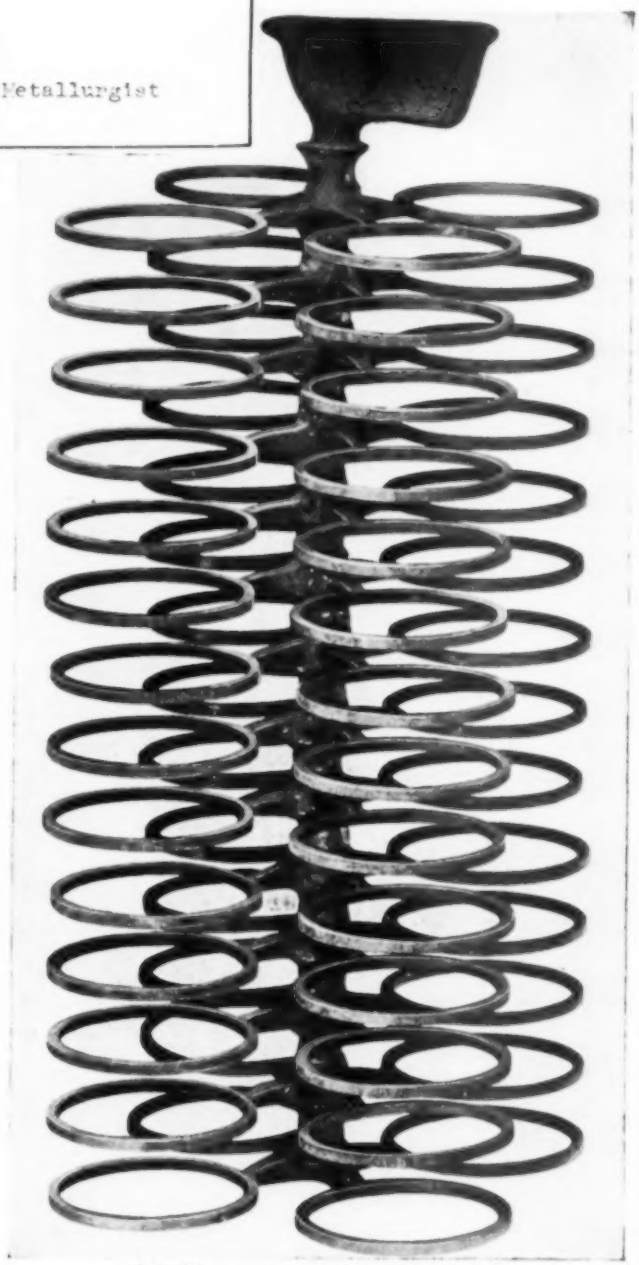
High quality is the primary consideration in the manufacture of piston ring castings. Uniformity of analysis, absence of hard spots and surface defects, factors which necessitate the closest supervision of melting practice, are obtained daily in this plant as a result of using the Griffin Hot-Blast Process.

This improvement in melting practice together with savings in fuel which alone justify the use of the Griffin Hot-Blast Process, are available to all foundries seeking to produce high grade castings at low cost.

Ask for cost and performance data, guarantees and references to other satisfied users, or at least have us send the latest Griffin Booklet.

Over a million tons have been melted in Griffin Hot-Blast Cupolas by one user alone



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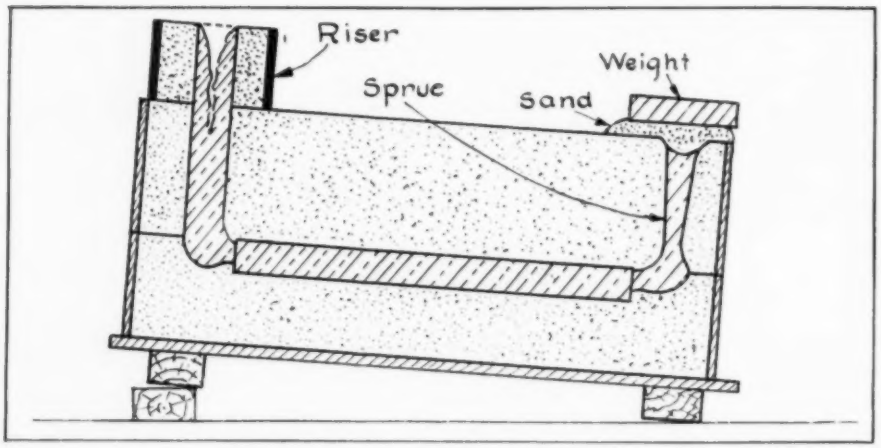


Fig. 197—Drossing in the metal was avoided by pouring through a gate at the lower end of the tilted mold

(*Continued from page* 38)

al. In this instance the copper was melted in crucibles and was protected from oxidizing influence by a thin covering of a proprietary flux which has a lighter specific gravity than molten copper. It floats on top of the molten metal and prevents the copper from absorbing oxygen while in a receptive condition. Care is exercised at all times in maintaining proper flame conditions in the furnaces, but if possible, a little extra care and attention should be paid.

Gated at the Bottom

The mold was made in a three-part flask to provide an opportunity of cutting a gate at the bottom, also so that a coating of plumbago might be applied readily to the surface of the sand. A heavy feeding riser was cut in the top of each mold and connected to a large riser designed to feed both castings.

In pouring the casting, the stream was stopped after the metal had filled the horizontal riser channel. The remainder of the riser cavity was filled directly by hot metal from the crucible. This metal, hot and clean, served its purpose as a feeding agent more acceptably than if cold metal had been forced up in the riser from the bottom. As a further precaution the metal in the riser was fed with a rod after the manner practiced in gray iron foundries. Great shrinkage cavities appeared in the tops of the riser, but the metal in the castings was solid.

Foundrymen unfamiliar with the behavior of copper while passing from the liquid to the solid state usually experience a great deal of trouble when they first essay the production of castings in this metal. Any one, or even a combination of several factors may be responsible for their lack of success, but the principal factor, the one responsible for the majority of defective castings, is employment of inadequate risers or feeders.

The nonferrous foundryman accustomed for years to producing castings in various alloys without the use of any, or in some instances, moderate size risers, finds difficulty in realizing that risers approximating those used in steel foundries are essential in producing solid copper castings.

This subject presented from the practical rather than the scientific or metallurgical standpoint was covered by R. R. Clarke in the March 1, 1928 issue of THE FOUNDRY. Slightly condensed it is included in this series as a valuable contribution to the general subject, preventing losses with proper gates and risers.

A charcoal covering is advised over the metal in the runner basin, particularly over the type of basin in which the sprue opening is covered with a plug. A layer of charcoal is spread over the bottom of the empty basin. The charcoal immediately floats to the top when the basin is filled with metal and serves as a protective coating during the pouring period. The metal is kept hot and fluid to a greater degree than if the upper surface was exposed to the atmosphere.

The shape or size of the gate may exert little or no influence on the subsequent shrinkage of the casting, but these factors certainly exert an important influence on the cleanliness of the casting. Many types of skim gates are available. The particular type to adopt in any given instance depends to a great extent on the shape and size of the casting. The distinctive feature of the skim gate is the *choke* or restricted area at some point between the sprue and the mold cavity. In the majority of instances the best place for the choke is close to the mold. With this arrangement the gate is filled with live active metal up to a point close to the mold. The temperature is maintained in the short passage between the choke and the casting.

Usually it is advisable to gate heavy copper castings at the bottom and to pour the metal through a sprue that may be kept filled while still large enough to fill the mold at a speed to prevent cold shuts. The filed sprue prevents the entrance of dross and scale. An experienced man usually can gage the gate area required to admit the metal at the proper speed, but in some instances it may be necessary on subsequent castings to increase this area. In these instances the gate should be widened rather than deepened to increase the size of the opening. An alternative method is to cut two or more shallow gates. A deep gate, particularly one connected to a large back passage or deep runner, may draw metal from the casting during the solidifying period.

Use Auxiliary Gates

Metal rising from the bottom of an extremely deep mold may cool to a dangerous degree before it reaches the top. Good practice dictates the use of auxiliary gates in cases of that kind. Entrance for fresh, hot metal from the same sprue is provided at a point midway between the bottom and top, also at a point at or near the top of the

(*Concluded on page* 42)

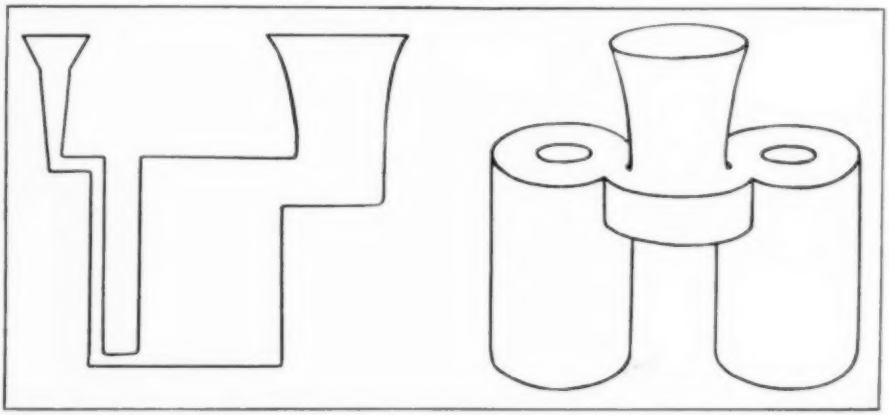
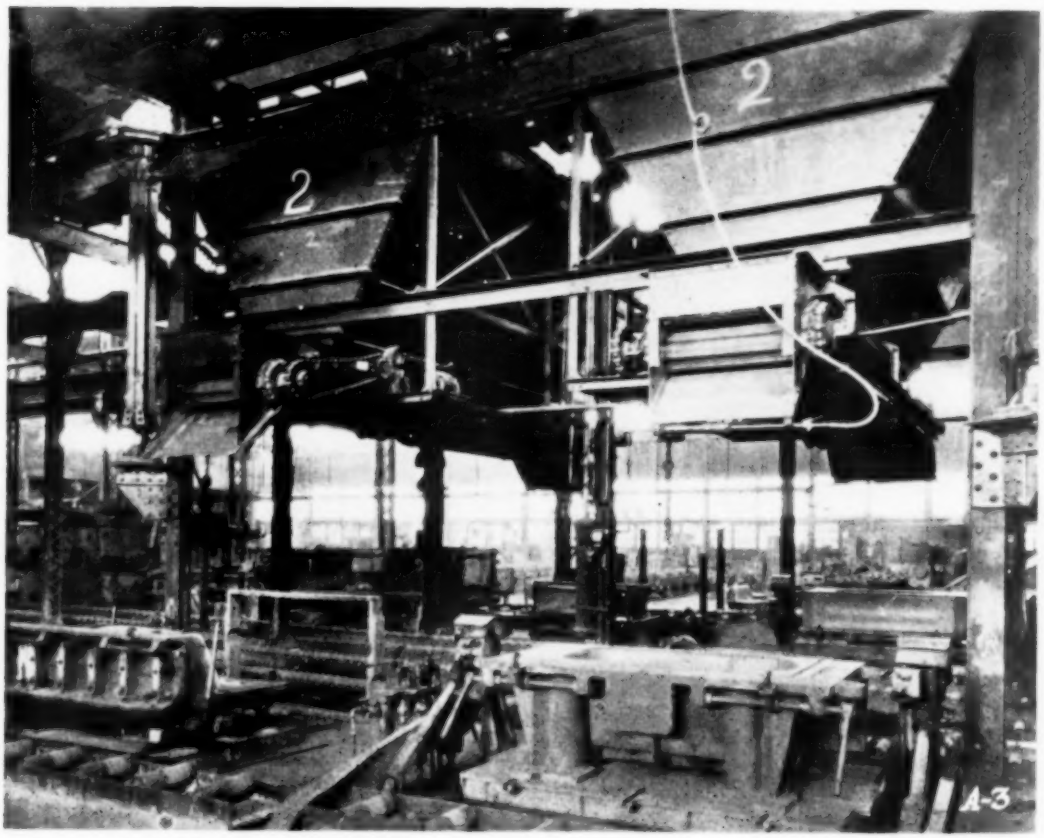


Fig. 198—Copper bushings made in pairs in a 3-part flask were gated at the bottom of the mold cavity

IF IT'S A HERMAN IT'S WORTH USING. IT MADE ITS WAY BY THE WAY IT'S MADE

HERMAN MOLDING MACHINES



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(*Concluded from page 40*)

mold cavity. An alternative method is to place a sprue at opposite sides of the mold. One leads to the bottom and the other leads to a point at any desired height between the bottom and top. Individual crucibles or ladles are employed to pour the metal into each sprue. In the second instance metal is poured first into the sprue leading to the bottom. The second ladle is brought into play approximately at the time the metal from the bottom has reached the second gate.

Illustration of a casting poured at three points, bottom, middle and top is shown at *A* Fig. 199. The casting was for a large copper welding arm containing cast-in pipes for circulating cooling water. In this instance the natural tendency of the metal to cool on the upward passage was intensified by the presence of the pipes which acted as internal chills.

Having discussed the gating features, attention now is directed to the abnormal shrinkage of heavy copper castings and the problem involved in providing measures to compensate for this shrinkage. The rapidity with which copper passes from the molten to the solid state serves to further complicate the problem. Solidification starts at the outside and works toward the center. As a result a perfectly adequate feeder—adequate in the respect that the metal in it remains fluid after the metal in the adjoining part of the casting has set—will fail to fulfill its function owing to the growth of a solid wall between the bottom of the feeder and the center of the casting.

An example of a copper casting involving special feeding features is shown at *B* Fig. 199. With any of the ordinary nonferrous alloys a fairly large gate with a heavy feeding sprue back of it at *C* would prevent shrinkage in the casting. A copper casting gated in the same manner would develop a shrinkage cavity under *E* and *D*. Recommended method is to gate the casting at the light end as shown and place a heavy feeder over the boss *E* and another (not shown) over the high flange *D*. A general rule to cover nearly all copper castings is to place large feeders on all high points and over heavy sections.

For the proper functioning of any feeder, two conditions absolutely are essential: 1—Fluidity of metal in the feeder must outlast that of the metal in the adjoining part of the casting. 2—Communication between the two bodies of metal must be kept open until the metal in the casting has set. These conditions apply to all metals, but to copper in a particular degree.

Shrink from Various Causes

Some metals shrink more than others. Furthermore the shrinkage in copper is localized in a manner to challenge prevention. Pipe cavities develop to an extent not found in any of the other ordinary nonferrous metals or alloys. An example of this tendency is shown at *K* Fig. 199, a casting molded on end and provided with a feeder on the top. When the feeder was removed, a pipe cavity was disclosed in the center extending half way through the casting. In this instance the feeder was too short, but the same type of defect may be traced to a feeder with insufficient volume, a feeder with a long neck, a small feeder, low temperature of the metal in the feeder which causes it to solidify before the metal in the casting.

Various examples of feeders and their effect on castings are shown in *F*, *G*, *H* and *J* Fig. 199. In example *F* the area of contact with the casting is too small. Even though the feeder was enlarged to the size and shape indicated by the dotted lines, the restricted neck would cause the metal to congeal at that point and thus defeat its purpose.

In *G* the reservoir is not the proper shape to prolong the life of the metal. If over size it might serve satisfactorily, but no foundryman favors the deliberate waste of metal. The feeder shown at *H* is adequate in size and shape, but unfortunately the neck is too long and this feature prevents utilization of the full benefit of the ample supply of metal above that area.

The correct method of applying a feeder on a copper casting is shown at *J*. The surface of the affected area is covered. The reservoir is ample to supply all the metal required. The neck is too short to interfere with the proper functioning of the feeder. It conforms to the dictates of common sense based on observation and long practical experience.

A round table discussion by gray iron, steel, nonferrous and pattern making, led by Charles Schermerhorn, featured the regular meeting of the Detroit Foundrymen's association held at Harmonie Hall, Detroit, on Feb. 16.

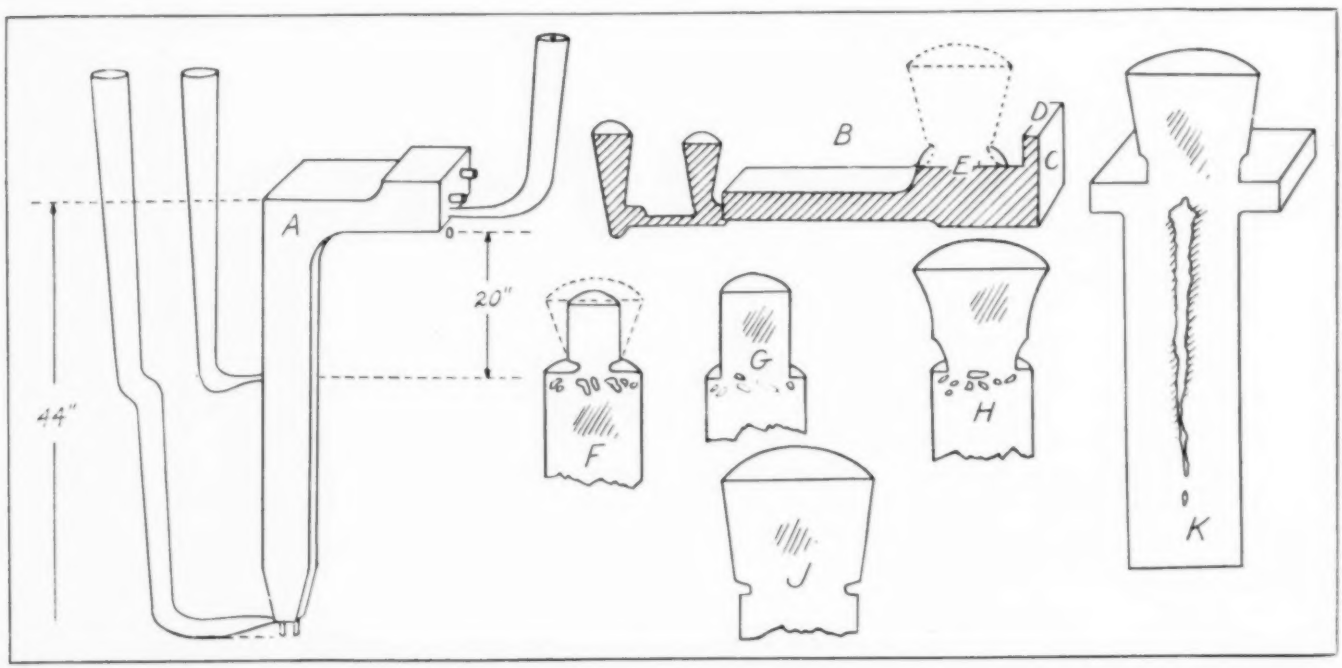

Fig. 199—A casting poured at three points is shown at the left. A copper casting involving special feeding features is shown at the right. Effects of different risers also are shown

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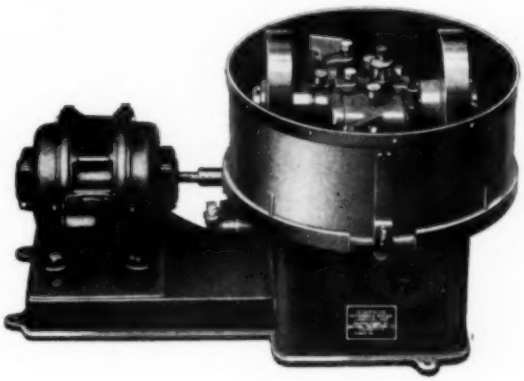

SAND CONDITION IS IMPORTANT

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Temperature Affects Sand

(*Concluded from Page* 12)

the sand surface. The author has observed by microscopical study of the grains of some quartzite-sands, that gases may be given off inside the same. This of course also contributes to expansion.

Sintering is a well-known fact. Usually sintering is accompanied by a contraction of the sand. Sometimes the sand melts from the surface and sinks down as a slag, sometimes the sand *shrinks*, draws away from the walls of the container and divides in several pieces.

Appearance of the surface after the test is very different. Some sands are quite unaffected of the heating, perhaps only changing in color a little. The surface is smooth and no sintering or shrinkage has taken place. Other sands show one or more of the above mentioned defects.

Sand Should Be Tested

The author has found that sands, which are unaffected by the heating test, work well if they are mixed with a suitable clay. Sands showing some kind of defect need not be rejected at once. Mixing with coal dust shows a remarkable effect on the expansion and the sintering. The sand therefore ought to be tested with the usual quantity of coal dust.

The clay also should be heat tested. The author has found that bad results in some foundries can be traced to clay used in making synthetic molding sand. By using the same type of heat-test on clay, interesting results are encountered. Some clays melt and give off great quantities of gas. They swell and overflow the border of the container, afterward they sink together and only a thin layer of slag remains. Good refractory clays practically are unaffected by the test.

In making synthetic sand it naturally is of great value to know that the sand as well as the clay has good heat resisting properties. Nevertheless the mixture also must be tested. While tested alone with good results, a refractory sand mixed with a clay may give a molding sand that shows strong expansion and forms considerable gas.

It was previously mentioned that foundrymen, believe that burning on depends upon the sintering point of the sand. Thus a high sintering point should indicate a low tendency by the sand to burn on. The author has found by determining the sintering point of the sands used in certain foundries that some of the sands had a rather low sintering point, but still gave castings with a good surface. The user of the sand had no complaints in that direction. It is logical to think that working conditions must have been different. The pouring temperature, the pressure and so on may have been different. Practical experience suggests that the burning on must depend upon following points: Chemical composition of the metal and the mineral constituents in the sand; pouring temperature; hydrostatic pressure of the metal; fluidity of the metal; wall thickness and construction of the casting.

Finds Different Results

Many foundrymen probably have had the same experience as the author, namely that different irons work differently against a certain sand. One iron has a velvet-like surface, while another iron shows a rough one. Charcoal iron works in the first-mentioned direction and also certain coke irons, while others *scratch* the sand to use a molder's expression. The action of low-carbon iron is especially severe, as was indicated on page 46 of the July 1, 1931 issue of THE FOUNDRY. It also is well-known that it is a problem to make magnesium and manganese steel castings with good surface. These circumstances must be due to chemical reactions between the sand and the metal or the oxides on the metal. The oxides MgO and MnO, having basic characteristics, will join with the SiO_2 in the sand forming a slag.

Mixing the sand with coal dust or coating the mold surface with a blacking is the usual way to provide a reducing atmosphere between the agents or to prevent them from coming into contact. The author also has tried successfully to use a basic sand for molding manganese steel and it is possible that further researches in that direction would give results.

Effect of the pouring temperature is easy to show by a practical test. At the technical university at Stockholm some research work on the burning on problem recently has been made and the results are interesting. The sintering point of certain sands were investigated and also the action of the sand at lower temperatures.

To expose all sands to exactly the same action of the metal is a burning on test and thus secure a fair comparison, the following test was made: Small prismatic test pieces 20 x 20 x 70 millimeters were made in a corebox, from the different sands as shown at D in Fig. 4. The specimen was made with three rams on the standard ramming device of A. F. A. The test pieces then were transfered and placed in models of the construction shown at C and E. In the model C the wall thickness is 6 millimeters and in E 20 millimeters. These models, with cores, then were molded in usual manner. Five molds were made from each model and these were poured at 1220, 1240, 1270, 1290 and 1390 degrees Cent. respectively (corresponding to 2228, 2264, 2318, 2372 and 2552 degrees Fahr.) After pouring the pieces were allowed to cool in the mold and great care was taken in the shaking out to keep the cores intact as shown in Fig. 5. Pieces were sawed in two and from more interesting parts small test pieces were cut out, placed in small brass rings and woods metal pounded around them. The pieces then were ground, polished and etched. One such test piece is shown in Fig. 3 This study and also the inspection of the castings after the cores had been cleaned gave the rather unexpected result, that no direct relation exists between the sintering point and the degree of the burning on action. Thus a sand, with the sintering point of 2642 degrees Fahr. already showed heavy burning on at a pouring temperature of 2318 degrees Fahr. while another with the sintering point by 2183 degrees showed no burning on with metal cast at 2264 degrees. In same cases the sand sintered to a cake but this did not *burn on* but loosened easily and left behind a good surface. Increasing the pouring temperature caused heavier "burning on."

Causes Metal Penetration

Hydrostatic pressure and the fluidity of the metal causes a penetration of the metal through the small channels between the sand grains. This penetration has nothing to do with the refractoriness of the sand. It has been the authors experience that a sand with rather low sintering point sometimes will withstand penetration better than a highly refractory sand. Sintering causes a melting together of the openings of the channels and thus keeps the metal outside, while in a highly refractory sand the channels will remain open. This also may be an explanation of the statement regarding the relation between sintering point and the burning on action. The penetration often is encountered in cores for bronze castings and sometimes also in iron castings. The way to overcome the trouble is to coat the surface of the core with a blacking that will withstand the pressure of metal. It is not enough to have a refractory sand.

Finally the wall thickness and the construction of the casting influences the burning action of the metal. In those places where the metal, owing to stagnated heat conduction, is kept in the molten state for a long time, for example around thin cores and in sharp corners, the action of the metal lasts longer and the sand is exposed greatly. Such places therefore must be especially well coated.

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Steel Casting Classifications

(*Concluded from page* 21)

building and contractors equipment makers; builders of cranes and derricks, all forms of materials handling, heavy machinery and presses; oil refining, barge and shipping, automotive, truck and tractor services and miscellaneous other smaller industrial users. The use of steel castings is so widespread that it is difficult to name any line of human endeavor which does not depend at some stage upon the product of steel foundries.

The diversities of type, character and required qualities in castings quite aside from all consideration of intricacy, coring, quantities, etc., made difficult any classifications for costing or price quotation purposes. Starting as a bulk commodity differing only in size and shape, steel castings have become highly specialized engineering structures, but nevertheless as definitely capable of classification as are the products of rolling mills.

Market Data Needed

The entire industry has suffered from lack of reliable market information and the consumer of steel castings has not benefited by the chaos which has existed. Speaking before a sales group, an influential steel foundryman some years ago deplored this condition, stating:

"To me the most deplorable feature of conducting the business of our industry is the lack of consideration given the naming of prices. Hours, days, weeks, months and even years will be devoted to consideration of means to reduce costs a fraction of a cent, but the establishing of prices is usually a matter of minutes and frequently pure guesswork."

Correction

The form containing the industrial steel castings classification starting on page 48 was printed with freight allowance and terms omitted. The latter will be found on page 58.

Recently, definite classifications representing established practice in grouping steel castings according to use and service, makes possible current quotations. This structure of prevailing prices has been compiled by THE FOUNDRY in cooperation with *Daily Metal Trade* and *Steel*. They represent the ordinary types of castings made to generally accepted specifications. In the interest of securing recognition by the foundry industry, THE FOUNDRY presents herewith some of the more important classifications. As the studies progress others may be added.

IRON AND STEEL WORKS CLASS

MISCELLANEOUS ROLLING MILL, STEEL WORKS AND BLAST FURNACE CASTINGS, INGOT AND CHARGING CAR BODIES

(Not otherwise specified in this list)

Pounds	Per Lb.
1 to 10	15.55c
Over 10 to 25	14.30c
Over 25 to 50	9.60c
Over 50 to 100	7.45c
Over 100 to 250	6.55c
Over 250 to 500	5.95c
Over 500 to 1000	5.20c
Over 1000 to 2500	4.75c
Over 2500 to 5000	4.55c
Over 5000	4.35c

Add 20% to above prices for all castings with water circulating pipes; hollow and disc table rollers and cylinders; rolling mill guides and table girders.

Add ¼c per lb. for carbon 0.40 to 0.70.

Extra charge for carbon above 0.70, and for alloys, depending upon analysis.

Add ¼c per lb. when chemical or physical tests are required.

Above prices to apply for charging box heads and ends; also hearth jackets and Bosh plates.

COUPLING BOXES, SPINDLES, ROLL HOUSINGS, PINION HOUSINGS, DROP BALLS, HAMMER RAMS AND HAMMER DIES

Pounds	Per Lb.
25 to 50	8.65c
Over 50 to 100	6.50c
Over 100 to 250	5.45c
Over 250 to 500	4.80c
Over 500 to 1000	4.20c
Over 1000 to 2500	4.15c
Over 2500 to 5000	4.10c
Over 5000 to 10000	4.05c
Over 10000 to 50000	3.95c
Over 50000	4.20c

Add 25% to above prices for hollow spindles.

Add ¼c per lb. for carbon 0.40 to 0.70.

Extra charge for carbon above 0.70, and for alloys, depending upon analysis.

Add ¼c per lb. when chemical or physical tests are required.

GEARS, GEAR BLANKS, GEAR SEGMENTS, RACKS AND PINIONS, AND CRANE CASTINGS, NOT SHOWN ELSEWHERE

Pounds	Per Lb.
1 to 10	15.75c
Over 10 to 25	13.65c
Over 25 to 50	10.50c
Over 50 to 100	8.30c
Over 100 to 250	7.60c
Over 250 to 500	6.35c
Over 500 to 1000	5.75c
Over 1000 to 2500	5.30c
Over 2500 to 5000	5.10c
Over 5000	4.75c

Add 20% to above prices for worms, worm wheels, sprockets, sheaves and pulleys.

Additional charge will be made for machine molded gears.

Railway motor gears not included in above schedule.

Add ¼c per lb. for carbon 0.40 to 0.70.

Extra charge for carbon above 0.70, and for alloys, depending upon analysis.

Add ¼c per lb. when chemical or physical tests are required.

Special prices will be quoted on brakewheels for cranes, bumper hoods, center stems, charging bar supports, charging rams, clutch castings, clutch rings, drums, drum gears, end carriages, gear clutch jaws, gear covers, guide brackets, hollow shafts and stems, long hollow racks, machinery girt castings, motor supports, peels and peel heads, ram frames, sheave guards, stripper rams and sleeves, trolley sides, truck castings and all other intricate crane castings.

ANNEALING POTS

Pounds	Per Lb.
500 to 1000	6.00c
Over 1000 to 2500	5.75c
Over 2500 to 5000	5.40c
Over 5000	5.15c

ANNEALING BOXES

Pounds	Per Lb.
1000 to 2500	5.90c
Over 2500 to 5000	5.65c
Over 5000 to 10000	5.40c
Over 10000 to 50000	5.15c

ANNEALING BOTTOMS

Pounds	Per Lb.
1000 to 2500	4.05c
Over 2500 to 5000	3.95c
Over 5000 to 10000	3.80c
Over 10000	3.60c

CHARGING BOXES

All weights ..... 4.75 Cts. per Lb.

Add ¼c per pound extra for double head boxes.

For charging box heads and ends, use miscellaneous schedule.

BLAST FURNACE BELLS

Pounds	Per Lb.
2500 to 5000	5.75c
Over 5000 to 10000	5.50c
Over 10000	5.25c

SLAG POTS, CINDER POTS AND HOT METAL LADLES

Pounds	Per Lb.
2500 to 5000	5.00c
Over 5000 to 10000	4.80c
Over 10000	4.60c

HOPPERS, HOPPER EXTENSIONS AND TUYERE JACKETS

Pounds	Per Lb.
500 to 1000	5.75c
Over 1000 to 2500	5.50c
Over 2500 to 5000	5.25c
Over 5000 to 10000	5.00c
Over 10000	4.90c

Add ½c per pound extra for hoppers cast in one piece.

Add 35% to above prices for blast hoods, blast hood tops and bosh supporting segments.

(*Continued on page* 48)

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MR. A. W. ROBERTSON, Chairman
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These men are selling this idea of immediate action to cut cost on present business and to prepare for coming business at a better profit by modernization. They are urging men to study their own operations now, find out how new machinery and new structures can reduce expenses and increase earnings—to face the consequence of neglected maintenance and repair. This is the very truth you have been telling them. But presented as a national emergency it is a new story with a new appeal.

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THE Committee on Industrial Rehabilitation was established last August as a national effort to promote the repair and re-equipment of factories, warehouses and large buildings, where such improvements will bring benefit through cost reduction, and by creating employment and stimulating business. Local committees are at work over the entire country and already commitments for more than $165,000,000 worth of rehabilitation work have been reported. 136-X

(*Continued from page* 46)

VALVE BODIES, TUYERE STOCKS, PIPES, NOZZLES, SADDLES, RINGS AND LIP RINGS

Pounds	Per Lb.
50 to 100	9.45c
Over 100 to 250	8.60c
Over 250 to 500	7.60c
Over 500 to 1000	6.45c
Over 1000	5.75c

FOR INDUSTRIALS ONLY

Physical Properties

SPECIFICATION A

Yield Point	55,000 pounds
Tensile Strength	85,000 pounds
Elongation	22%
Reduction of Area	40%

Physical Properties

SPECIFICATION B

Yield Point	60,000 pounds
Tensile Strength	90,000 pounds
Elongation	25%
Reduction of Area	50%

BRIDGE BLOCKS, BASES AND SHOES

Pounds	Per Lb.
Under 500	5.00c
Over 500 to 1000	4.75c
Over 1000 to 2500	4.50c
Over 2500	4.00c

GEAR CASTINGS FOR BRIDGES ONLY

Pounds	Per Lb.
1 to 10	15.75c
Over 10 to 25	13.65c
Over 25 to 50	10.50c
Over 50 to 100	8.30c
Over 100 to 250	7.60c
Over 250 to 500	6.35c
Over 500 to 1000	5.75c
Over 1000 to 2500	5.30c
Over 2500 to 5000	5.10c
Over 5000	4.75c

OTHER BRIDGE CASTINGS

Pounds	Per Lb.
1 to 10	15.55c
Over 10 to 25	14.30c
Over 25 to 50	9.60c
Over 50 to 100	7.45c
Over 100 to 250	6.55c
Over 250 to 500	5.95c
Over 500 to 1000	5.20c
Over 1000 to 2500	4.75c
Over 2500 to 5000	4.55c
Over 5000	4.35c

A separate price to be quoted for patterns and a separate price to be quoted for machining.

For corrosion resisting castings—special extra price to be quoted.

For specification A add 1.50c per lb.

For specification B add 2.50c per lb.

HYDRAULIC PRESS MACHINERY CASTINGS

Pounds	Cents per Pound 1-9 Pieces	10 Pieces and over
1 to 5	20.00	19.00
Over 5 to 10	17.00	16.00
Over 10 to 25	15.00	14.00
Over 25 to 50	12.50	10.00
Over 50 to 100	9.50	8.50
Over 100 to 250	7.00	6.60
Over 250 to 500	6.50	6.00
Over 500 to 1000	5.20	5.00
Over 1000 to 2500	4.75	4.60
Over 2500 to 5000	4.55	4.45
Over 5000	4.35	.....

For specification A add 1.50c per lb.

For specification B add 2.50c per lb.

CASTINGS FOR BOILERS, TANKS, FLANGED VALVES AND FLANGED FITTINGS

Working Pressure Castings

Weight in Pounds	Price in Cents Per Pound 1-9 Pieces	10-24 Pieces	25-49 Pieces	50-99 Pieces	100 Pieces and Over
1 to 5	22.50	21.50	19.50	18.00	16.50
Over 5 to 10	19.50	18.50	16.50	15.00	13.50
Over 10 to 25	17.50	16.50	14.50	12.50	11.50
Over 25 to 50	15.00	12.50	11.00	10.25	9.50
Over 50 to 100	12.00	11.00	10.00	9.00	8.50
Over 100 to 250	9.50	9.10	8.75	8.50	8.25
Over 250 to 500	9.00	8.50	7.95	7.85	7.75
Over 500 to 1000	8.45	7.70	7.50	7.35	7.25
Over 1000 to 2500	8.00	7.25	7.10	7.00	6.95
Over 2500 to 5000	7.80	7.05	6.95	6.85	6.80
Over 5000	7.60	6.85	6.75	6.70	6.65

Special prices to be quoted for sinuous headers, water walls, screwed valves and fittings, mud drums and heat exchangers.

For specification A add 1.50c per lb. For specification B add 2.50c per lb.

FLAT COMPANION TYPE FLANGES AND PLAIN RING AND ANGLE OR "L" SECTION FLANGES

Weight in Pounds	Price in Cents Per Pound 1-9 Pieces	10-24 Pieces	25 Pieces and Over
1 to 10	14.55	14.05	13.55
Over 10 to 25	13.30	12.80	12.30
Over 25 to 50	8.60	8.10	7.60
Over 50 to 100	7.50	7.00	6.50
Over 100 to 250	7.00	6.25	5.50
Over 250 to 500	6.40	5.65	5.00
Over 500	6.00	5.25	4.60

Over 7 feet in diameter—special prices

For specification A add 1.50c per lb. For specification B add 2.50c per lb.

For corrosion and heat resisting castings—special extra prices to be quoted.

Suitable pattern equipment to be furnished by customer.

BARGE CASTINGS

MISCELLANEOUS CASTINGS

Weight in Pounds	Price in Cents Per Pound 1-9 Pieces	10-49 Pieces	50 Pieces and Over
10 to 25	15.55	14.55	13.55
Over 25 to 50	9.60	9.00	8.60
Over 50 to 100	7.45	6.85	6.50
Over 100 to 250	6.55	6.00	5.75
Over 250 to 500	5.95	5.35	5.25
Over 500 to 1000	5.20	5.10	5.00
Over 1000 to 2500	4.75	4.60	4.50
Over 2500 to 5000	4.55	4.45	.....
Over 5000	4.35	.....	.....

BARGE DOUBLE AND SINGLE BITTS, KEVELS AND CHOCKS

Weight in Pounds	Price in Cents Per Pound 1-9 Pieces	10-50 Pieces	51 Pieces and Over
25 to 50	6.00	5.35	5.15
Over 50 to 100	5.75	5.15	4.90
Over 100 to 250	5.50	4.90	4.75
Over 250	5.00	4.75	4.50

BARGE CORNER CASTINGS, HATCH FRAMES AND COVERS

Weight in Pounds	Price in Cents Per Pound 1-9 Pieces	10-50 Pieces	51 Pieces and Over
25 to 50	8.50	7.75	7.25
Over 50 to 100	7.50	6.75	6.25
Over 100	6.50	5.75	5.25

All inspection fees paid by purchaser.

For specification A add 1.50c per lb. For specification B add 2.50c per lb.

SHIP CASTINGS

Weight in Pounds	Price in Cents Per Pound				
	1-9 Pieces	10-24 Pieces	25-49 Pieces	50-99 Pieces	100 Pieces and Over
1 to 5	20.00	19.00	17.00	15.50	14.00
Over 5 to 10	17.00	16.00	14.00	12.50	11.00
Over 10 to 25	15.00	14.00	12.00	10.00	9.00
Over 25 to 50	12.50	10.00	8.50	7.75	7.00
Over 50 to 100	9.50	8.50	7.50	6.50	6.00
Over 100 to 250	8.00	7.60	7.25	.....	.....
Over 250 to 500	7.50	7.00	6.45	.....	.....
Over 500 to 1000	6.20	.....	.....	.....	.....
Over 1000 to 2500	5.75	.....	.....	.....	.....
Over 2500 to 5000	5.55	.....	.....	.....	.....
Over 5000	5.35	.....	.....	.....	.....

NOTE: The above prices include all ship castings *except* rudders, rudder posts, rudder frames, spectakle frames, struts, stern frames, stems, quadrants and hawse pipe. Special price to apply to these castings.

NOTE: Propeller wheels—use first column only—add 2c per pound.

For specifications A add 1.50c per pound. For specification B add 2.50c per pound.

All inspection fees paid by purchaser.

Driver Must Provide Accurate Information in Case of Accident

IN SPITE of driver training which has been discussed in recent issues of THE FOUNDRY, accidents will occur. It is so important to know what to do at such times that full instructions on this subject should be among the first given every new driver and old drivers should be rehearsed in them from time to time.

Keeping adequate accident records also is an indispensable auxiliary to an effective driver-training program Such records will show when certain conditions repeatedly figure in accidents and will indicate need of special instructions or disciplinary action.

All new drivers, old drivers and all personnel concerned with accidents should be prepared by previous instruction to deal with accidents in a way to minimize their serious consequences. No driver ever should leave the garage without having in his possession a report card telling him what to do and what information to get in the event of an accident. An excellent form for that purpose is supplied by certain insurance companies.

Common sense and human decency will prompt a driver to do the first thing necessary after an accident—everything possible to care for any one hurt. As soon as that is attended to, or at once if no one was injured, he should take his report card and enter the names and addresses of witnesses and other information that will be needed for insurance adjustments and possible damage suits.

Much subsequent trouble will be avoided usually if the driver does not assume himself to blame nor accuse another. Under no circumstances should he be discourteous or lose his temper. He will have the advantage of the situation if he keeps cool.

As drivers will be the principal source of information about accidents they should be impressed with the necessity for the company to have full, true and unbiased information. A driver's failure to report an accident of any consequence should be punished by dismissal.

The National Safety council gives an excellent definition of what constitutes a reportable accident:

A reportable accident shall be any accident in which the vehicle is involved, unless properly parked, where such accident results in death, personal injury or property damage, regardless of who was hurt, what property was damaged, or who was responsible.

Some require a report of any mishap however trivial if it has accident potentialities. Information from minor accidents may be fully as important as that from serious ones in building up an accident-prevention program and also may be valuable in defeating fraudulent damage claims that often follow.

Immediately following the accident a more complete vehicle accident report should be filled out by the driver or better by some official from his testimony. This report is for the permanent records and covers facts regarding causes, circumstances and results. Large fleet owners usually have a form of their own to cover all of the information that their experience has found important. Small fleets having relatively infrequent use for such forms will be better supplied and at less expense if they obtain from the National Safety council, Chicago, its *Vehicle Accident Report* form.

While drivers will be loath to admit responsibility and will be tempted to falsify or withhold facts that condemn them, obtaining the truth is essential to developing efficient, safe driving. It will help to bring out the true facts if drivers are given to understand that their making a "clean breast of it" if they were to blame will incline the management to leniency, whereas their covering up anything will go bad with them if it is discovered.

Experience from past accidents should be made the basis of study to improve the safety record. From the individual accident reports a periodic summary and analysis should be made. It affords comparisons from one period to another and between the divisions of a fleet. From a study of data thus collected many things will be learned about accident trends, usually making it possible to devise measures for reducing hazards involved or increasing precautions to combat them. Corrective measures should be applied to individuals immediately after an accident, but the study of a number of accidents will be necessary to disclose any faults existing in the conduct of the safety program as a whole. In general it is important to know:

What type of accident occurs most frequently.

Where most accidents happen.

What actions of drivers are involved in most accidents.

What conditions of road, the weather, or light, figure most prominently in accidents.

What personal injuries for property damage result from accidents.

What should be done to eliminate the causes.

What reductions have been made in outstanding causes.

Which employees are accident-prone.

Pittsburgh Group Learns of Open Hearths

Howard G. Grim, superintendent of the open-hearth department, Heppenstall & Co., manufacturers of high grade steel and forgings, Pittsburgh, addressed the Pittsburgh Foundrymen's association at the Ft. Pitt hotel, Feb. 20. His subject was "An Ideal Natural Gas Fired Open Hearth Furnace."

Mr. Grim has had considerable experience in the open-hearth practice in the Pittsburgh district and is a lieutenant in the ordinance department of the reserve corp of the United States army. He is a graduate of the University of Pittsburgh school of mines with the degree of metallurgical engineer.

This was the regular monthly meeting of the Pittsburgh Foundrymen's association. The next meeting is scheduled for Monday evening March 20.

Oxygen in Acid Electric Steel

(*Continued from page* 14)

tap the metal analyzed 0.23 per cent carbon, 0.67 per cent manganese and 0.73 per cent silicon. At second tap it analyzed 0.18 per cent carbon, 0.58 per cent manganese and 0.70 per cent silicon.

Batty has given examples of this condition in basic electric practice. The general English practice, at the time this condition was noted, was to add sufficient silicon after removing the oxidizing slag, to deoxidize the bath and leave about 0.10 per cent silicon in the steel. As additions of carbon were made to the slag some silicon would be derived by reduction from the slag. He cites examples: "I was unable to get a sufficiently high spoon test in a number of heats which were required for shanking small work. In each of these cases the slag was too good, that is the reducing conditions were too perfect, hence the steel being low in dissolved oxides was low in fluidity. In one case I followed up an experience related to me by Melmoth, namely, I had both doors open for about 3 minutes, allowing a current of air to pass through the furnace and oxidize the slag slightly. Within 3 minutes after this was done a spoon time test was taken which was quite satisfactory and the metal was *finished* and cast. It would be logical to expect that with the doors open, the temperature of the bath would have fallen, but, even if this drop in temperature did occur there was undoubtedly an appreciable increase in the fluidity of the metal."

Prevents Porous Condition

While it is quite possible to produce sound castings without the use of aluminum, it generally and advisedly is used in production of castings in green sand molds to prevent porous condition arising as the result of the injection of mold gases into the steel. It has been proven repeatedly that metal which is competent to produce perfectly sound castings in dry or skin-dried molds may not produce equally sound castings from straight green sand molds. As the metal is the same as it enters each mold, the variant must be the mold and as the only apparent variant in the three types of mold is the moisture content, this must be the culprit in the formation of pin holes in well made steel.

Aluminum, by its rapid reaction with oxygen to form alumina and possibly by causing an increased solvent power of the metal for hydrogen and nitrogen, prevents formation of the pin holes, but while it cures one trouble it usually causes another; namely, decreased ductility.

Quite a striking demonstration of the origin of pin hole trouble is provided in the test mold which is standard in the foundries of the Steel Castings Development bureau. This is illustrated in Fig. 2 which shows a section cut through a mold and test block and is truly indicative of the conditions that pertain. One shoulder is produced in a dry sand core, the remainder of the mold being green sand. A test of this kind provides evidence of the value of the green sand as a molding medium and as such is a useful indication of sand condition and is profitably used in combination with the usual sand control methods of permeability tests and moisture determinations, serving to amplify them. Fig. 2 shows a condition indicative of unsuitable green sand and indicates the fact that the metal is constitutionally good because there are no blows or pin holes from the dry sand shoulder of the mold, whereas from the green sand shoulder, when this part is disproportionately heated, there is an evolution of gas—largely water vapor or, possibly, the dissociation products of water—that penetrates the initially solidified envelope and forms pin holes.

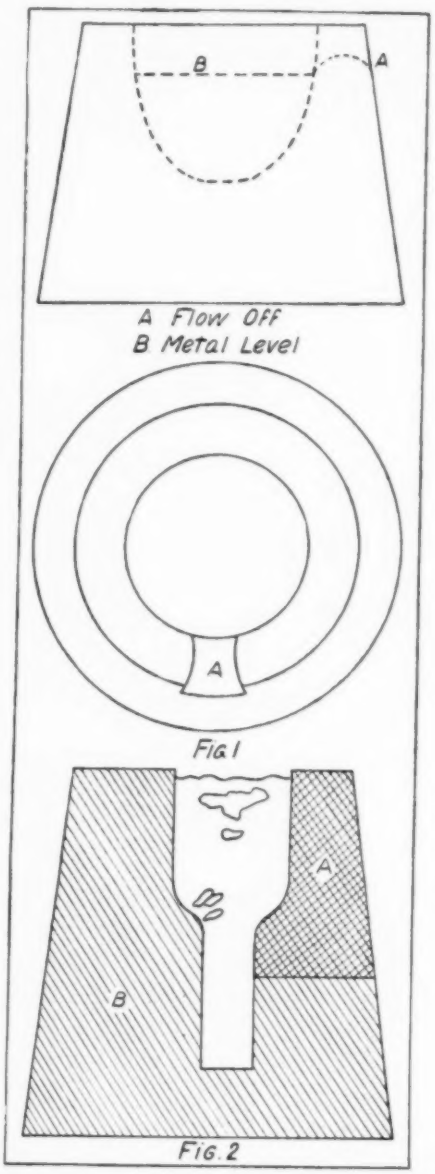

Fig. 1—Fluidity core test. Fig. 2—Condition indicative of unsuitable green sand

Aluminum also seems to have an indirect effect upon the sulphide arrangement in steels causing them to be arranged in a streaky formation. The reason for this may lie in aluminum's effect upon the small amounts of iron oxide remanent in a normal steel after deoxidation with ferrosilicon and ferromanganese. Sulphur, as sulphides of iron and manganese, is in solution in molten steel, precipitating out of solution as inclusions as the metal starts to solidify. Iron oxide decreases the solubility of these sulphides and causes them to precipitate earlier than if no iron oxide were present, and they are thus able to assume a roughly globular shape. With increased solubility they are precipitated with the last metal to solidify and assume a network structure. This type of inclusion is particularly harmful, causing a decided depreciation in the ductility of the steel.

Used as Precaution

The fact that this condition may be found in steels not treated with aluminum and quite often not in steels so treated indicates that this element is not directly blamable. It quite often is found in steels over-reduced with nascent silicon, a fact which seems to indicate a necessity for some small amount of iron oxide to prevent this condition. Tests have proven conclusively the rectitude of this belief.

As aluminum tends to confer on the steel a certain degree of capability to resist the depreciating effects of mold gases and as no other material capable of serving this same purpose is at present available, it is necesasry to use it as a precautionary measure in green sand castings.

Incidental to the use of aluminum is the manner in which it should be added to the steel. As it has been proven capable of reducing the slaggy oxides of silicon, manganese and iron to form alumina, which shows little power of coalescence, and tends to form dangerous inclusions, care should be exercised in its introduction. If it is thrown into the stream during the tapping operation it is quite liable to be wasted by reacting with slag carried into the ladle as a result of careless tapping procedure, or possibly by reaction with atmospheric oxygen. Therefore it is suggested that aluminum be added by wiring it to a heavy rod

(*Concluded on page* 52)

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(*Concluded from page* 50)

and plunging it to the bottom of the ladle when all the metal is in the ladle and the slag begins to flow from the furnace. Holding back the slag is essential.

Any further addition of aluminum deemed necessary in the handshanks should be made in the stream flowing from the large ladle so as to avoid atmospheric oxidation of aluminum at this time. The addition of small pieces of aluminum to the stream of metal as it enters the mold is to be depreciated as being likely to produce uneven aluminum distribution through the casting and possibly hard spots as a consequence.

As a small, undetermined amount of iron oxide seems necessary in a steel used to produce satisfactory steel castings, it seems advisable to so produce the steel that silicon is not reduced from the slag to enter the metal and to so control the composition of molding sand that the minimum addition of aluminum is required to produce castings regularly unafflicted with the pin hole defect.

Engineers and Foundrymen Hold Meeting

Technical papers and addresses discussing foundry practices and trends, an exchange of ideas on foundry and engineering progress, visits to industrial plants, and social events featured the 2 day meeting of the Birmingham section of the American Society of Mechanical Engineers and local members of the American Foundrymen's association in Birmingham, Feb. 13 and 14.

An address on "History of Foundry Advancement in Southeast," by J. R. McWane, president McWane Cast Iron Pipe Co., a foundryman for more than 35 years, was the highlight of the luncheon on the second day, attended by more than 100 engineers and foundrymen. Mr. McWane told how his father, after the Civil war, started a small hand foundry in his own yard at his home, in Virginia. From this beginning, members of his family have been responsible melting 2,500,000 tons of pig iron, more than one-half of which was used in the Birmingham industries. He spoke on self-help, the need of depending on one's own resources. Outside capital is another fallacy in the mind of Mr. McWane, capital being the least thing needed in the success of industry. Ability to run it, nerve to develop it and character to stay with it are far more important than capital in his estimation. He advocated the making of something different and if the old production is maintained, make it differently. He stated that if we are to succeed, we must not only try new things in a new way, but we must have the nerve to give up and disregard certain things when it comes to that point. Persistence and stubborness are the same thing only modified by good judgment.

J. T. McKenzie, chief chemist, American Cast Iron Pipe Co., Birmingham spoke on "Significance of the Transverse Test in Cast Iron." He described the transverse testing of cast iron, sources of error in making the tests and the machines commonly used for the purpose. He spoke on the interpretation of the values obtained in terms applicable to engineering calculations and showed the influence of shape and mass of section on these properties. The data from the transverse test was then correlated with some of the most important engineering properties such as tensile, compressing shear and impact strength and with the endurance limit.

F. B. Riggan, chief chemist, Stockham Pipe & Fittings Co., Birmingham spoke on "The Malleable Cast Iron of Today—Some Aspects of its Use in New Specialized Fields," touching on the relation of malleable cast iron to some of the other ferrous metals. He presented notes on the part that malleable cast iron has played in the engineering field in the past and some aspects as to its economic use in certain specialized fields. He told of the demand of the engineer for new materials that will give a more satisfactory performance in highly specialized duties.

The concluding event of the program was the dinner-meeting, presided over by S. D. Moxley, chief engineer, American Cast Iron Pipe Co. Karl Landgrebe, vice-president, Tennessee Coal, Iron & Railroad Co. as toastmaster and W. D. Moore, president American Cast Iron Pipe Co. introduced the speaker of the evening, Gen. T. S. Hammond, Chicago, president American Foundrymen's association and president Illinois Manufacturers association. The speaker's theme was the effect of the "pressure of groups" upon the government with its resultant tax load on industry and the individual. The "pressure groups," described as political, include the farm group, the labor group and the veterans' group and he told of the demands being made on the government, all of which means greater requirements, resulting in higher taxes.

Numerous plants in the Birmingham section were inspected.

"Iron Ore, Pig Iron and Steel in 1931" is the subject of a pamphlet recently published by the U. S. department of commerce, bureau of mines. The work was prepared by W. Davis and may be secured through the superintendent of documents, Washington, for five cents.

Michigan State To Hold Short Course

Problems pertaining to gray iron castings manufacture, nonferrous practice and general foundry procedure will be discussed by leaders in the various fields at a short course on foundry work to be held at Michigan State college, Lansing, Mich., on April 6, 7 and 8. The course has been arranged by Frederick G. Seffing, metallurgist, division of engineering, department of mechanical engineering, with the Detroit Foundrymen's association co-operating. The program for the meeting is as follows:

Thursday, April 6

Registration

10:00 a.m.—General session, F. G. Seffing, chairman.
"New Foundry Developments," by Pat Dwyer, THE FOUNDRY, Cleveland.

2:00 p.m.—Gray iron session, A. L. Boegehold, General Motors Research Corp., Detroit, and John Grennan, University of Michigan, Ann Arbor, Mich., chairmen.
"Brackelsburg Furnace and Converter Practice in the Foundry," by D. J. Reese, Whiting Corp., Harvey, Ill.
"Electric Furnace Practice," by A. H. Rhoads, Detroit Electric Furnace Co., Detroit.
"Cupola Control in the Future," by J. L. Brooks, Sparta Foundry Co., Sparta, Mich.
"Air Furnace," by H. M. Lane, Hickman Williams & Co., Detroit.

2:00 p.m.—Nonferrous session, Charles A. Hill, Mueller Brass Co., Port Huron, Mich., chairman.
"Babbitts and Bronzes," by E. R. Darby, Federal Mogul Corp., Detroit.
"Brasses," by H. M. St. John, Detroit Lubricator Co., Detroit.

7:30 p.m.—General session, J. D. Stoddard, Detroit Testing Laboratory, Detroit, chairman.
"Testing, Spectroscopy, Radiographs and Dry Polishing."

Friday, April 7

9:00 a.m.—General session, H. L. Campbell, University of Michigan, Ann Arbor, Mich., and L. G. Corte, Riley Stoker Corp., Detroit, chairmen.
"Sand Control," by Harry W. Dietert, U. S. Radiator Corp., Detroit.

2:00 p.m.—Gray iron session, Fred Erb, Eaton-Erb Foundry Co., Detroit, and Mr. Miller, Windsor, Ont., chairmen.
"Alloy Irons," by L. A. Danse, Cadillac Motor Car Co., Detroit.
"Heat Treatment of Cast Iron," by Fred Walls, Wilson Foundry & Machine Co., Pontiac, Mich.

2:00 p.m.—Nonferrous session, Vaughn Reid, City Pattern Works, Detroit, and C. H. Morrison, Bohn Aluminum Works, Detroit, chairmen.
"Aluminum Melting," by T. D. Stay, Aluminum Co. of America, Cleveland.
"Heat Treatment of Aluminum Alloys," by H. J. Deutsch, U. S. Aluminum Co., Detroit.

6:30 p.m.—Banquet, S. Wells Utley, president, Detroit Steel Casting Co., Detroit, speaker.

Saturday, April 8

9:00 a.m.—General session, F. X. Mushynski, American Car & Foundry Co., Detroit, and H. J. Fisher, Novo Engine Works, Lansing, Mich., chairmen.
"Cleaning Castings," by M. T. Mortenson, W. W. Sly Mfg. Co., Cleveland.
"Silicosis in the Foundry," by C. E. Vessey, W. W. Sly Mfg. Co., Cleveland.

Although arranged primarily for foundrymen of Michigan, anyone interested is welcome to attend. A registration fee of $5 includes the ticket for the banquet to be held Friday evening, with S. Wells Utley as speaker.

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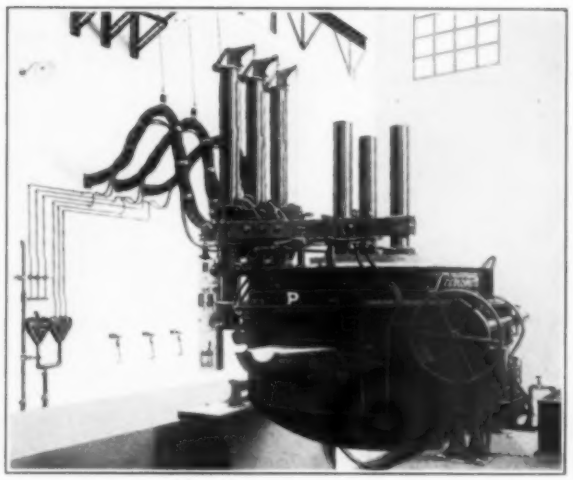

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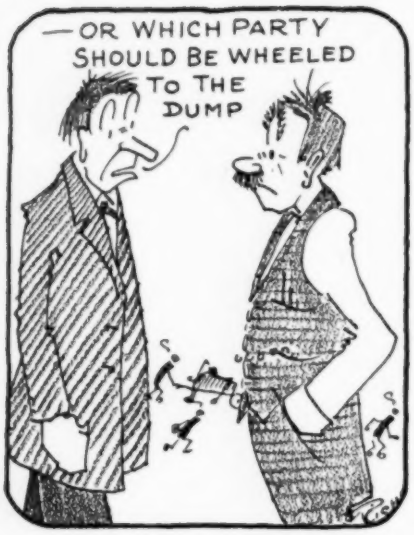


Good is interred with their bones

The Adventures of Bill

BY PAT DWYER

"WELL," said Bill the other night, "according to what I hear from the neighbors occasionally, the victorious army marched into Washington on March 4 according to schedule and proceeded to dig themselves in for an anticipated four year siege. The opposing army marched out with all the honors of war and with everything else which had not been shipped out in advance and cached at strategic points. After a short period of rest the clarion call will go forth to gird up the loins and so forth and we shall see an invading army again advancing on the Capitol, with banners bravely flying and the same old line of baloney employed by their opponents in the previous campaign. The see-saw has been going on now for over 150 years and the intelligent electorate has not come to a decision yet as to which party should be maintained in power, or, to put it another way, which party should be wheeled out to the dump and left there."

"Before going any farther," I said, "in condemning all your fellow citizens merely because they exercise that most sacred and priceless of all privileges, the privilege of changing their minds, might I ask what you mean by saying you collected all your information from the conversation of your neighbors? Don't you read the papers? The daily press, sees all, knows nothing and tells all? The great universal disseminator of news, any kind of news so long as it is sensational? The self appointed teacher of the people, the champion of free speech, the bulwark of civilization, the—the—"

"—government of the people, for the people and by the people shall be decided in a great measure by the manner in which the news is presented in the papers! Sure," Bill concluded for me, "that is the reason I don't read 'em any more. After the election was over and the political news pot had settled down to a gentle simmering instead of boiling over, I ventured to take a peep at a few pages occasionally. Then the technocratic fox broke out of his Columbia mountain covert and the entire pack of news beagles with the unerring nose for a new scent, trailed away in full cry and I found I was not able to keep up. Some of the words in these technocratical stories have been dredged from fathomless deeps in the dictionary—virgin territory, never disturbed since Webster took the words, and like Little Boy Blue, kissed them and placed them there. The years have been many, the years have been long, har, har, says you, almost as long as some of the words!

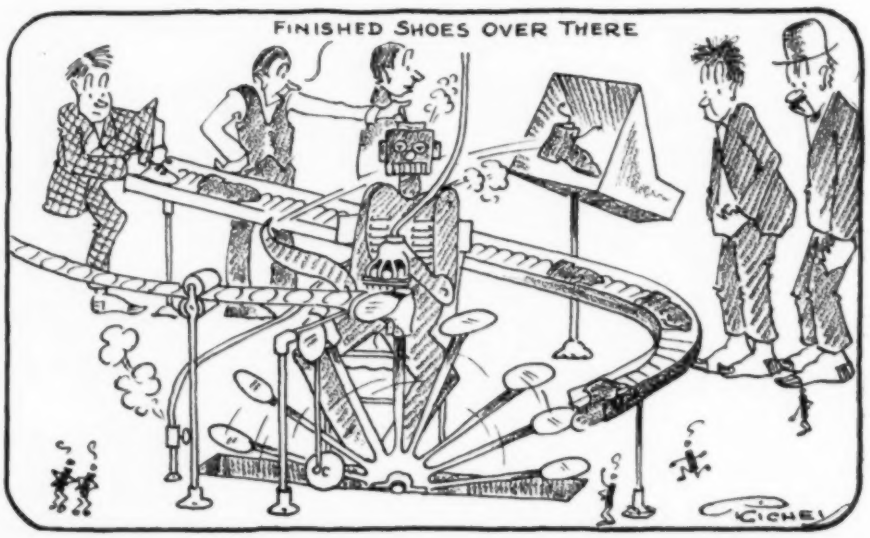
"Other words with which I am more or less familiar, just the common run of mine stuff, or, to change the metaphor, words seined from near the surface of the sea of language, have been grouped in such fearful and wonderful combinations that they convey no meaning to my mind. Maybe I am just plain dumb, but there it is. That's my story and I am going to stick to it. The technocracy stories are too deep—or too high—suit yourself—for me, so why should I waste any time reading them?

"Figures are juggled around in a manner never approached by even the most accomplished and expert business statisticians and you know how these lads can throw them around. Any point they wish to illustrate, or any fact that needs or seems to need a few figures to back it up, why, these birds can fish 'em up as readily as a stage magician can bring rabbits, pop corn oranges, pigeons, pine apples, prunes and guinea pigs out of a high silk hat.

"Other figures which if quoted or otherwise placed on display, might cause them embarrassment, are suppressed, ignored, or made to disappear with the same magical celerity. The quickness of the hand deceives the eye and you are allowed to see just exactly as little or as much as the performer desires you to see."

"I think you are doing these men a grave injustice," I said, "Presumably they get their figures from official records of some kind. Take, for example, the output of boots and shoes in the year 1800—"

"All right," Bill agreed heartily, "take the year 1800 when the population of the country was a little more than 5,000,000. With this figure for a foundation and the fur-



Technocracy is sunk—Many soles lost

ther fact gleaned from ancient records that a skilled shoemaker could turn out a pair of shoes per day, the technocratic spell binder divides the 5,000,000 pairs of shoes needed annually, by the 300 working days and arrives at the astonishing conclusion that 16,666 shoemakers found employment at that period. Having established this point he applies the same set of figures to the present output of shoes and proves that the machine has thrown several million men out of work.

"The fallacy of this argument is that it presents certain plausible factors and ignores others. At the period selected for illustration it is quite probable that 25 per cent of the population walked barefoot part or all the time. Another 25 per cent wore moccasins or other home made foot wear. Instances are on record of stout cow hide shoes, regularly greased with tallow, that served their owners for four or five years. Certainly a considerable volume of boots and shoes was imported from Europe.

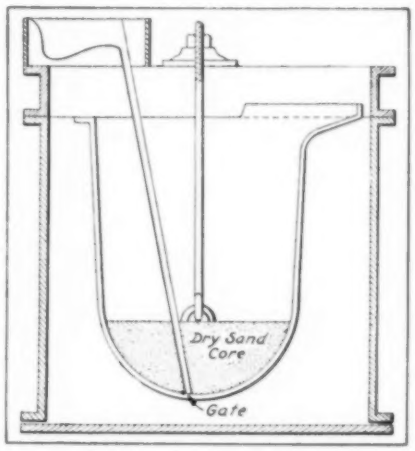
"Now my lad if 16,666 (the last 6 is a repeater) shoemakers were required in 1800 to make 10 per cent of the shoes required by 5,000,000 people, how many men would be required under similar conditions to make the shoes—from 2 to 12 pairs—in the present year 1933 for 120,000,000 people? Every second man in the country would be bent over a shoemaker's bench. Who would be left to fill the roles of the butcher, the baker, the candlestick maker?"

"That is an exaggerated example," I claimed, "You can't play tricks with ordinary figures in that manner. Two and two still make four."

"Two and two might make four in your hands," Bill said, "but in the hands of an expert, two and two could appear as 22. Take another familiar example: The consensus of opinion among those who have compared notes on the subject is that the immense population of the world is descended from one original pair, Adam and Eve. They are known under different names by different nationalities, but the general belief is the same. A clever figurer can reverse this pyramid by directing your attention to the fact that while you have only one father and mother, you have two grandfathers and two grandmothers. Each of these in turn had two ancestors and so on into infinity. By carrying the calculation back for a few thousand years you can prove that you had more ancestors than Adam had descendants.

"I think that is enough on that subject for one day. If you are sufficiently interested I shall tell you a story about a man who operates a general jobbing gray iron foundry and who had been asked to quote on some melting pots for an aluminum foundry in the same district. The volume of business would not amount to more than two dozen pots per year, therefore he had no opportunity or excuse for installing elaborate equipment. He was undecided whether to mold the pots mouth up or mouth down. He was kind enough to say he would appreciate my opinion on that point, also on any other feature worthy of comment under the peculiar circumstances.

"Theoretically one of these pots cast mouth down should be as satisfactory as one cast in the opposite position. In fact in some foundries all pots are cast in that position, with the mound of sand designed to form the inside of the pot, standing on the drag. One of the advantages of that method is the bottom of the new pot will be the same thickness as the pattern. Unless special precautions are taken the same cannot be said of pots cast mouth up. However—and this is just another illustration of the difference between theory and practice—unless the mound of sand on the drag is rammed and vented properly, it will cause the metal to flutter over the surface. The resulting casting may be defective enough to warrant instant condemnation, or, the porous area may remain concealed until some time after the pot has been placed in service. From the customer's view point, the second condition is worse than the first. In either case the blame is placed on the position in which the casting was poured, when in strict justice the blame should be placed on the sand or in the manner in which it was manipulated.



The inside bottom of the pot is formed by a dry sand core

"I made him a little sketch showing a longitudinal section of one of these pot molds set up and ready to receive the molten iron. This sketch illustrates the method and equipment employed in a foundry where a considerable number of aluminum melting pots are made each year.

"Flasks and bottom plate are cast iron. In an emergency a wood flask would serve, but it would soon work loose and would not be sufficiently rigid to insure a casting of uniform thickness.

"The two distinctive features of the molding method shown in the illustration are the device for supporting the large body of green sand suspended from the cope, and the long sprue extending from the runner basin to a point inside and near the center of the bottom of the pot. Introducing the metal in this manner insures a minimum of disturbance to the sand.

"Theoretically the most advantageous position to gate this casting is at the top, preferably through a ring of small pop gates connected to a circular basin. With that type of gate the metal in the bottom of the pot would set first and the last hot metal would remain in the top of the casting. In other words each succeeding inch of metal as it ascended in the mold would feed that part of the casting below. However, in actual practice the type of gate shown in the illustration yields fairly satisfactory service, even if all the metal in the casting has to be driven up from the bottom.

"In practice the aluminum pattern is placed on a rollover board and enclosed in a drag which then is rammed full of sand and rolled over in the usual manner. A spherical section of core sand prepared previously and dried in the oven is placed in the bottom of the pattern. This dry sand core is provided with a steel loop or staple anchored securely in the sand either to a small arbor or a few rods. The hook end of a long steel bolt is attached to the loop in the core and then the remainder of space inside the pot pattern is rammed.

The cope then is lowered into place and—if the pot is large—wedges are driven between the tops of the core standards and the bottom edges of the cope bars. On smaller pots this precaution is not required. After the cope has been rammed, a suitable plate and washer are placed on top around the bolt and the nut is screwed down tightly. The runner basin is made up and then the cope is lifted off. Usually the pattern comes with the cope. The molder supports the weight of the pattern for a moment while he raps it with a hammer or mallet. He then releases his hand and the pattern drops to the floor.

"The iron mixture for the pots is made up of 30 per cent pig iron, 40 per cent steel scrap and the remainder machinery scrap. To this he adds nickel 1.50 to 2.00 per cent and chromium 0.70 to 0.80 per cent. The metal conforms approximately to the following analysis: Total carbon 3.00 to 3.30 per cent; silicon 1.00 to 1.20 per cent, sulphur under 0.10 per cent; phosphorus 0.30 per cent; manganese 0.50 to 0.70 per cent.

Reproduces Work in Bronze

(*Concluded from page 27*)

would seem to indicate that the horse reserved to himself the speed at which he should travel and the direction in which he should go. This hypothesis is strengthened by the pose of the two figures. The rider apparently wishes to go in one direction, while the horse fully is determined to go in another.

Authentic information is lacking on the process employed in molding and casting these various figures, but it is reasonable to assume that the piece mold method was adopted. None is so intricate as to require adoption of the *cire perdue* or lost wax process. A plain cope and drag with possibly a few drawbacks would suffice for Figs. 2, 6, and 8. A greater number of pieces would be required for the other figures. The horse and rider in Fig. 5 were cast in sections. All that part of the figure below the rider's waist formed one casting. The torso, head and arms of the man formed the second part. The two parts afterward were assembled and fastened at the waist line with a *Roman joint*.

Describes Roman Joint

In this type of joint, invented by the ancient Roman bronze foundrymen and never improved down to the present, a projecting ridge of one casting fits into a recess in the second casting. Bolts or rivets are employed to hold the parts together and then the ridge is hammered down and rubbed smooth. The result is an undistinguishable joint. Large figures usually are provided with internal flanges or lugs for the reception of bolts.

Detailed descriptions of molding large pieces of statuary have appeared in THE FOUNDRY on several occasions. Briefly, a plaster replica of the sculptor's clay figure is used for a pattern in the foundry. The outside is molded in a cope and drag with a sufficient number of separate pieces of drawbacks to facilitate the removal of the pattern. After the pattern has been removed, the mold is reassembled and the cavity packed full of sand to form the core. A suitable arbor is built in the mold before it is closed.

For work of this character, both cope and drag are barred. Each has to be lifted in turn and treated as a cope. The drag is partly filled with sand and the pattern is bedded in temporarily. At the beginning of the process the drag merely serves as a follow board. A parting line is established and then the cope with all the necessary loose pieces is rammed in place. The entire assembly is rolled over. The temporary drag is removed and the sand is shaken out. The drag flask then is returned to place and the second half of the mold with all necessary loose pieces or drawbacks is rammed. In the next step the drag is lifted off and the pattern is removed from the inverted cope.

At this point the molding procedure differs from that employed in other foundries. The drag is returned to place on the cope and the entire interior of the mold is rammed full of sand to form the core. The drag once more is removed while the molder skilfully removes a thickness of sand from the core to correspond with the desired thickness of metal in the proposed casting. Obviously he only can remove this thickness of sand from the exposed or drag half of the core. The drag is again placed in position on the cope and the entire assembly is rolled over. The cope is removed and placed on the oven car in an inverted position and the molder removes the required thickness of sand from the core which in this instance is resting in the drag. Projecting members, or small rods, extensions of the arbor, hold it in place. Drag and core are dried as a unit. Afterward the mold is assembled and filled with metal through a number of small grates connected to a basin or reservoir on top of the cope.

Several methods are available for molding the large fish pool casting shown in Fig. 4. This casting with ½-inch thickness of metal in the body is 3 feet deep and 5 feet in diameter. The method in any given instance would depend to a great extent on the available flask and crane capacity. In accordance with the methods usually employed in statuary and art foundries, it is altogether probable that the casting was molded bottom side up in a loam mold below the floor level. Pattern-making was held to a minimum by the use of a spindle and sweep.

With the spindle in place, the inside wall was built to the required height, then capped with a plate provided with dabbers to anchor the crown bricks and with holes to permit the escape of gas to the center. Two courses of bricks at the outside bottom of the wall were extended to form a circular step or guide for the cope. A thickness of loam was swept all over the exposed surface and allowed to dry.

Strips of clay ½-inch in thickness were applied to the face of the core to correspond with the required thickness of metal in the casting. The sculptor then modeled the embossed figures of the swimmers, fish, etc., and applied them to the clay surface. The outside part of the mold was built on a lifting plate in the usual manner and a seat was swept on top of the wall to locate the cope plate. The cope plate was provided with twelve 4-inch diameter openings for the accommodation of twelve ⅜ x 2-inch gates disposed in a ring corresponding with the periphery of the mold at the upper joint.

Cheek and cope might have been built as a unit, and probably would be built in that manner if extended crane facilities were not available. In former times, bells were molded in this manner. The cope was lifted straight up from the core a sufficient distance for the molder to work under it. Later it was lowered and the entire mold was dried as a unit, in place, and from a fire built inside the core.

Whether the mold was made in two or three parts, the clay thickness strips and the figures in relief came away with the cheek. They were removed from the cheek part of the mold during the finishing process. Then the mold was reassembled and poured from a basin or reservoir connected to the twelve small rectangular pop gates.

Addresses Meeting Of Wisconsin Group

Dr. O. A. Sander, medical director, Employers' Mutual Liability Insurance Co., addressed the regular meeting of the Wisconsis Gray Iron Foundry group at at the Hotel Schroeder, Milwaukee, Feb. 15. In speaking of the dust problem in the foundry, Dr. Sander described the process by which finely divided silica dust may enter the lungs and cause a breakdown of lung tissue. He illustrated his talk with numerous case reports and demonstrated the interpretation of X-ray photograps of workers.

Prof. Richard S. McCaffery, department of metallurgy, University of Wisconsin, Madison, Wis., presided and 57 members were present.

Talks Before New Foundrymen's Group

H. Bornstein, Deere & Co., Moline, Ill., addressed the regular meeting of the newly formed Rock River Valley Foundrymen's association on Feb. 21 at the Hotel Freeport, Freeport, Ill. Mr. Bornstein spoke on "Cast Iron as an Engineering Material" and illustrated his talk with lantern slides.

The next meeting of the association will be held in Rockford on March 21.

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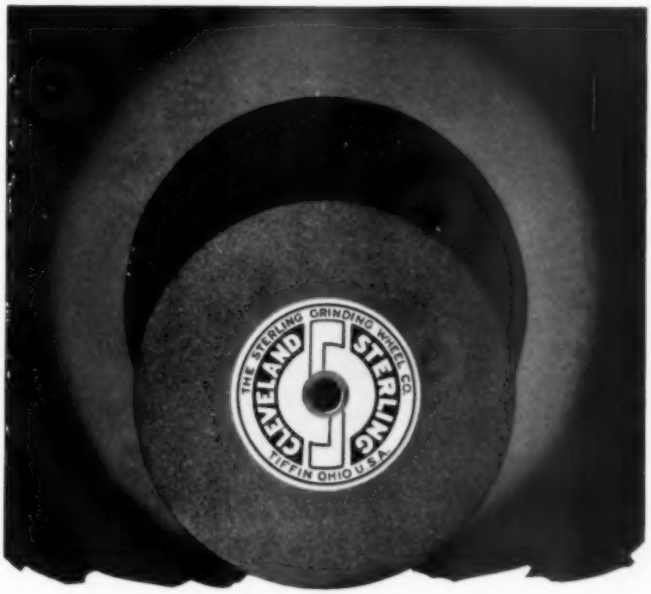

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The Foundry Through the Years

(*Concluded from page* 23)

issue. Features included a new contents page containing a special short article on various uses of castings; a page entitled "Selling the Output—What Industry Needs Today Is Sales" and signed by Phineas, Jr.; and an enlarged editorial page presented under the name of "The Shakeout."

The theme introduced immediately before the Milwaukee convention was hammered home in each issue from the beginning of the year. Editors of THE FOUNDRY realized the seriousness of the situation presented by what it chose to call the "New Competition," and utilized almost every type of article in its campaign of service to the foundry industry. In the Jan. 1 issue, Dan M. Avey told of successful merchandising methods adopted by the Detroit Gray Iron Foundry Co., under the heading "Blazes Trail to Jobbing Profits," and in the Jan. 15 number, Bert Ulehake wrote an interesting article on "Production Schedule Aids Steel Foundry Sales."

Other articles, presented in successive issues and dealing with the subject of sales, were as follows: "Trademarks Prove Effective in Pulling Repeat Orders" by Frank G. Steinebach; "How Does the P. A. Get That Way" by A Victim; "Who Is To Blame for the P. A.'s Slant on Buying Castings" by A Victim; "What Does the P. A. Buy" by A Victim; "Selling Special Castings" by Dan M. Avey; "How a Southern Jobbing Shop Developed Its Market" by Charles R. Law; "Sells Castings by Stressing Quality Rather than Price"; "Selling Permanent Mold Castings Demands Time and Patience" by Pat Dwyer. The articles continued throughout the year, and aroused such enthusiasm that it became a topic of discussion wherever foundrymen met.

Industry Suffers Loss

In April, THE FOUNDRY, the castings industry and all association activity was bowed in sorrow with the passing of A. O. Backert, editor of THE FOUNDRY, past president of the American Foundrymen's association, and an international figure in the foundry industry. His genius and energy was in large measure responsible in lifting the A. F. A. from obscurity to a position of world wide eminence among technical organizations. As THE FOUNDRY spoke in the May 1 issue, "He accomplished much in a short span of years."

Syracuse entertained the A. F. A. convention and exhibition in 1925, the show and technical meetings being held at the state fair grounds. The weather was cold and damp, but as THE FOUNDRY pointed out, this failed to daunt the foundrymen attending, and a profitable meeting from every standpoint resulted. A. B. Root Jr., Hunt-Spiller Mfg. Corp., Boston, was elected president and S. Wells Utley, Detroit Steel Casting Co., Detroit, vice president of the association.

All the talk occasioned by the three articles by A Victim, previously mentioned, produced some smoke and a little fire. John C. Dinsmore, vice president, National Association of Purchasing agents, rose in defense of the members of his organization, and in three articles entitled "Rush Orders Complicate Traffic", "Should User Buy Castings By Piece or the Pound", and "What Is Wanted of the Purchasing Agent", presented the other side of the argument. Old A Victim presented his rebuttal in "Inaccuracies Shown in the P. A.'s Slant," and comment from many readers of THE FOUNDRY continued to roll in to the editorial office.

Permanent Mold Progress

Early in 1926, THE FOUNDRY presented a series of four articles tracing all of the work which had been done up to that time in the development of permanent or long life molds. In the Feb. 15 and two succeeding issues, Frank A. Foster, for many years a resident of the Orient, wrote interestingly on "Ancient Chinese Excelled in Making Delicate Art Castings." In the March 1 issue a new problem was tackled when for the first time the subject of synthetic sands was discussed from all angles. After an exhaustive survey, Pat Dwyer prepared a series of articles on "Can Used Sand Be Reclaimed?" In the June 15 issue, THE FOUNDRY presented color plates in the data sheet section, showing the standard pattern colors adopted by the A. F. A. and since accepted by all other organizations interested. "Avoiding Embrittlement in Malleable" was discussed by Edwin Bremer, now metallurgical editor of THE FOUNDRY.

In September, the "Detroit convention crowns apex of thirty years attainment" for the A. F. A. This was the first Internationl Congress in America, and drew a large delegation from the leading foundry countries of Europe. The meeting transcended all previous gatherings, with 6000 foundrymen registered, and the largest exhibition in history, three large buildings at the state fair grounds being used for the purpose.

Business on the whole was good throughout the year. The country was prosperous, and in spite of some unsound practices in merchandising, the foundry industry likewise reflected prosperity.

F. G. S.

Correction

APPLYING TO INDUSTRIALS ONLY

(See Page 48)

FREIGHT ALLOWANCE

The prices are for steel castings, not machined, f.o.b. foundry, with published rate of freight allowed to the freight station nearest Purchaser's Works, within the following boundary lines:

All points in the United States included within the line drawn from Boston, Mass., through Schenectady, Rochester and Niagara Falls, N. Y., Toledo, O., Ohio-Indiana State Line, Cincinnati, Newport, and Ashland, Ky., Huntington, and Charleston, W. Va. Washington, Cape May, N. J., and all Atlantic Ocean terminal points between Cape May and Boston.

Suitable pattern equipment is to be furnished by the purchaser, f.o.b. foundry.

TERMS

Cash settlement shall be made before the 25th of each month for all material shipped during the preceding month.

NOTE: Castings proving defective in workmanship or material and rejected, will be replaced under the same terms and conditions as originally furnished. No claims for damages, labor or other expenses, on material furnished, will be allowed unless authorized in writing. All agreements contingent upon strikes, accidents or other causes beyond our control. No liability will be assumed for any special, indirect or consequential damages whatsoever.

A. F. A. Plans Program For Chicago

(*Concluded from page* 15)

iron castings, a joint work of the A. F. A. and the A. S. T. M. will be held the week following the A. F. A. meeting, during the A. S. T. M. annual convention.

An extensive variety of new equipment, developed in the two years since the previous foundry exhibition, will be on display in the exhibition hall of the Stevens hotel. It is confidently predicted that this feature of the convention will do much to enable foundrymen to meet new situations brought about by present economic conditions.

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Cupola Practice for Malleable

(*Continued from page* 25)

terials should be made with extreme care. Gates and sprues should be milled so that they will be free from sand and thin rusty steel never should be used. Oxidized iron, cold and sluggish will result from steel coated with thick rust and its use should be avoided. A purchasing agent may find the market price of this material cheap but his firm will pay dearly for it in the end.

The malleable cupola should be equipped with a good volume-meter and pressure gage. At regular intervals the melter should check the volume and pressure of the air entering the cupola, and the information thus obtained will indicate just what is going on inside his furnace. Besides a great deal of guess work will be eliminated.

Continuous Melting

Melting in the malleable cupola should be continuous. That is to say, after the blower is started and the stream of metal begins to run over the trough it should be allowed to run continuously until the required amount of metal is melted and the days work is over. Using the cupola as a reservoir, except for short intervals is not considered good practice. If iron is collected in an outside ladle much hotter iron may be obtained and a more consistent carbon maintained. While this method has a few disadvantages, its advantages are legion. One of the disadvantages is the problem of slagging, or rather the results of slagging. Due to the high temperature of the metal and use of soda-ash in the ladle which is now standard practice with many, cutting and burning out of the breast, trough and ladle results unless the best fire brick obtainable are used. Slagging at the back of the cupola is not practical which makes it necessary to slag through the breast or tap hole. This slag also attacks the brick in the breast and trough and they cut out badly during a day's operation. However, if extreme care is used in building them, and good material used the minimum trouble will result.

The spout may be arranged for front slagging. Both the iron and slag flow through a tap-hole into a trap. The iron continues to flow under a cut-off, into the spout and into the mixing ladle, while the slag will float on top and is drawn off through a slag notch. A trough leads from the slag notch to a slag pot which is rolled up by the side of the cupola. As the pot is filled it is drawn off and another set in its place.

A mixing ladle of the tea-pot type should be used to catch the metal as it flows from the trough. Its capacity should be equivalent to at least the weight of one charge of metal entering the cupola. Some melters prefer an even larger ladle which it is claimed gives better mixing.

The rate of melting should be so timed that at the end of each charge melted, soda-ash will be thrown in the mixing ladle, allowed to dissolve thoroughly and the slag that is thus formed, flow off through a notch provided for the purpose in the back of the ladle. This should always be done after the reaction has taken place, and the soda-ash has served its purpose. Approximately 0.015 per cent of sulphur will be removed from the metal by that method and a little manganese also is lost. This operation should be repeated from charge to charge during the entire heat.

Ordinarily a malleable cupola operating continuously will give satisfactory results for about 10 hours. After that period trouble develops, and it seems uneconomical to try longer operation. Inspection of the breast, trough and mixing ladle after a long heat will show them to be rather badly burned out. In fact, if the utmost care is not used in lining the ladle and the trough, and the best refractories used, the cupola will not go the ten hours. To lessen the chance of excessive oxidation of the last iron it is a good plan when the heat is over to drop through one charge, or use the iron from the last charge for pouring annealing pots or other castings that are not important.

Possibly no metal requires closer metallurgical control than malleable iron. Making the mixture therefore is important and a general knowledge of the effect of the different elements on the iron as well as their influence on the annealing operation is desirable and necessary. Because of the double influence of silicon, sulphur, phosphorus and manganese, the constitution of malleable iron becomes exceedingly complicated. Silicon and sulphur control the condition of the carbon to a large extent, for silicon acts as a precipitant of carbon driving it out of the combined form into the graphitic form. For that reason the proportion of silicon will depend on the size of the casting and the amount of total carbon. As these increase silicon must decrease or black iron will result. However, the higher the silicon in the casting, the quicker the temper carbon will come out during the anneal. For tin castings, it is desirable that the total carbon plus the silicon equal 3.80 per cent and for heavier castings 3.55 per cent. Under good conditions in melting, about 10 per cent of the silicon will be burned out.

Sulphur increases the tendency of castings to check. Due to the contraction of white iron, it is desirable to keep sulphur as low as possible. It also reduces the strength of a casting and the ease of the annealing. Approximately 0.045 per cent sulphur will be taken up from the coke during melting.

Manganese within certain limits has many advantages. It prevents checking and protects silicon from oxidation during the melting. It also protects silicon and the iron itself from oxidation during the anneal and in this way hastens precipitation of temper carbon and prevents scaled castings. Above 0.6 per cent manganese acts as a hardener which, of course, makes castings difficult to anneal. Manganese should equal twice the sulphur value plus 0.20 per cent. Approximately 15 per cent manganese will be lost during the melting.

Phosphorus has but one good quality, its tendency to make the metal fluid. However, when silicon and total carbon are proportioned correctly this quality is not needed especially since the disadvantages of phosphorus are so numerous. High phosphorus makes annealed casting hard and difficult to machine, liable to check and above all diminishes malleable most valuable property, its resistance to shock or strain. Amounts over 0.10 per cent should not be permitted. Phosphorus in the mixture going in the cupola usually remains the same.

Regulate Carbon

Low total carbon will cause dull cold iron, weak castings and make them difficult to machine. Therefore it is a part of the melters' duty to check his coke and regulate the carbon. From 2.75 to 3 per cent ordinarily is the right amount to carry.

Analysis of the castings, depending on their size, before they are annealed, should run as follows:

Silicon .....0.60 to 1.00 per cent
Manganese .....0.30 to 50 per cent
Phosphorus ....Under 0.10 per cent
Sulphur .....Under 0.110 per cent
Total carbon..2.75 to 3.00 per cent

The analysis is obtained by mixing pig iron with various amounts of malleable scrap, gates, sprues and hard iron, and steel. In making up the mixture, however, the consummation of the gates, sprues and feeders becomes a real problem since they often weigh more than the castings themselves.

To record this information, it is advisable to provide a form or mixture sheet which will record the composition of the various factors making up the charge, such as pig

iron, returned scrap and steel. This card also may show the total weight of silicon, manganese, phosphorus and sulphur charged, the percentage of each of these elements in the mixture, the percentage lost or gained and the net percentage remaining. The amount of the elements added and the net and actual analysis of the metal is included.

A complete and accurate history of each day's operation or heat should also be recorded. From these the melter can obtain comparative information that will be extremely useful to him.

Standard Covers Steel Flanged Fittings

A new American standard for steel flanged fittings and companion flanges, replacing a former American tentative standard, has been approved by the American Standards association. Pressure ratings of 300 and 1500 pounds per square inch, respectively, replace in the new standard the old tentative standard ratings of 250 and 1300 pounds per square inch.

The new standard covers the same flanged fittings as the old with the addition of fittings for a maximum steam service pressure of 150 pounds per square inch at 500 degrees Fahr. or 100 pounds per square inch at 750 degrees Fahr. and flanged base-fittings for pressures of 300, 400, 600 and 900 pounds per square inch. The work on the project is jointly sponsored by the American Society of Mechanical Engineers, the Manufacturers Standardization Society of the Valve and Fittings Industry, and the Heating and Piping Contractors National association.

The new standard may be secured from the American Standards association, 29 West 39th Street, New York, for 65 cents.

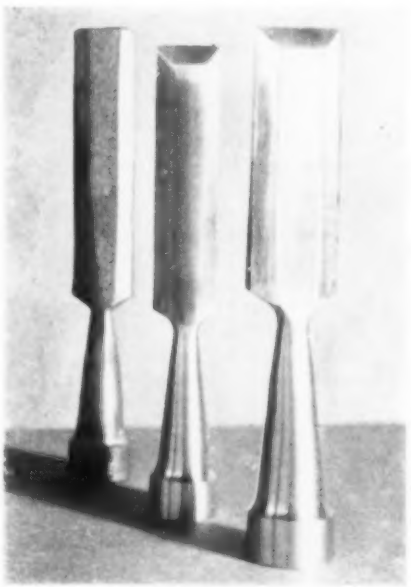
Discuss Iron As Engineering Material

H. Bornstein, Deere & Co., Moline, Ill., addressed the regular meeting of the Quad-City Foundrymen's association held Monday, Feb. 20 at the Hotel LeClaire, Moline, Ill. Mr. Bornstein spoke on "Cast Iron as an Engineering Material" and defined and classified white metal, malleable and gray iron. Slides showing microstructures were used to illustrate the talk.

Charles F. Scherer, Davenport Machine & Foundry Co., Davenport, presided at the meeting in which 60 were present. A class of 25 apprentices in pattern making also attended. The next regular meeting will be held on March 20 at Rock Island, Ill.

Develops Chisels Which Are Cast To Shape

Woodworking chisels cast of Z-Metal represent a new development pioneered by Gunite Foundries Corp., Rockford, Ill. These chisels are cast to shape, hardened, tempered and polished to the form suitable for



Woodworking chisels cast of Z-metal. The chisel as cast is shown on the left

service. The chisels while showing a lower Rockwell hardness than forged steel, develop a cutting edge that is durable and effective. Patternmakers who use the chisels report that they are as serviceable as any previously attainable.

Good Housekeeping At Falks

(*Concluded from page* 18)

he was working. The mixture used consisted of silica flour, molasses and water. There was, of course, a source of dust in the handling of the dry silica flour and considerable time was consumed in mixing the wash. Furthermore, the usual thing was to mix more than was needed and the wash that was left over was allowed to remain in the bucket until needed again. More often than not, the silica had settled to the bottom and the entire mixture was useless.

Buckets used for the handling of the wash are hung from hooks underneath the platform shown in Fig. 1 and, before replacing them, helpers must wash out the buckets and swabs in an adjacent concrete tank which is provided with running water.

Combining the improvements mentioned in this article with a closer check on inventory of supplies and materials and an increased cost consciousness in our supervisory staff which was brought about by a series of cost conferences, we feel that we have materially improved the conditions in our plant both from the standpoint of cost and from the standpoint of the health of the employes. In so doing, we have provided, and are providing, employment for our men and are confident that we shall be ready to hit our stride when business is once more on the old basis.

Points To Value Of Laboratory Control

O. G. Willey, metallurgist, Jenkins Bros. Co., Bridgeport, Conn., addressed the regular meeting of the Connecticut Nonferrous Foundrymen's association held at the Hotel Garde, New Haven, Conn., Feb. 13. Mr. Willey spoke on "Laboratory Control of the Foundry" and showed clearly the benefits to be derived and the economy possible through control of metal mixtures in the foundry by a plant laboratory. An interesting discussion followed the talk, with C. H. Blanchard, Reading Pratt & Cady Co., Hartford, Conn., presiding.

W. M. Saunders, chemist and metallurgist, Whitehead Brothers Co., Providence, R. I., will address the group on April 10 on the subject of "Foundry Sand."

Report Covers Study on Welding

A report of an investigation conducted by the engineering experiment station, Purdue university, Lafayette, Ind., in co-operation with the Utilities Research Commission, Inc., recently has been published by the university in a bulletin entitled "Welding with Manufactured, Natural and Mixed Gas." The report was prepared by H. H. Lurie, research associate, engineering experiment station, and may be obtained from that organization for 50 cents.

Pat Dwyer Visits St. Louis Foundrymen

Patrick Dwyer, engineering editor of THE FOUNDRY, was the principal speaker at a meeting of the St. Louis Foundrymen's club held at the American hotel annex this evening. Mr. Dwyer's address covered various phases of the technical and business problems encountered in the foundry industry today. H. C. Sanders, American Foundry & Mfg. Co., St. Louis, is president of the club.

Heat Treat Iron Castings

(*Concluded from page 20*)

ence with the particular iron the right temperature and time is a matter of cut and try. An anneal with slow cool following will break down the desirable pearlitic matrix, which, of course, results in too great softness and loss in strength in the body of the casting. While no hard and fast rules can be laid down, if maximum physical properties must be retained, it may prove necessary to follow the high temperature period with a quench and draw. If a mottled iron—an iron containing pearlite, graphite and cementite simultaneously and throughout its structure—or a white iron be properly treated, it is possible to produce what is called *semimalleable*. In the production of semimalleable maximum annealing temperature may be around 1700-1750 degrees. After soaking up to 3 hours the castings are cooled in the furnace to about 1400 degrees Fahr. They then may be air quenched, oil quenched and drawn, or cooled in the furnace, depending on the result required.

If a low carbon, low silicon iron, 2.00-2.50 per cent carbon and 1.00-1.50 silicon, is used it is possible to produce material well over 60,000 pounds per square inch or even over 75,000 pounds per square inch, and also to obtain some ductility. Brinell hardness may be from 150 up, depending on the iron and on the quench employed.

The high temperature anneal, and in case of mottled iron the presence of graphite flakes as cast, leads carbon formations which are between the flakes of gray iron and the nodules of true malleable.

Quenching treatments usually consist of heating to about 1500 degrees, holding just long enough to get complete heat penetration, and quenching. Oil is the usual quenching medium. As a rule air quenching is so slow that instead of hoped for hardening, actual softening of the metal may occur. Water quenching frequently proves too drastic and the metal may be made excessively brittle. The bugbear in quenching of cast irons is graphitization. If the treatment results in more graphite and less combined carbon, desired hardness will not be attained and the presence of an increased amount of graphite frequently results both in embrittlement and weakening of the metal. The steel heat treater is fortunate in that he does not have to contend with this troublesome factor, graphitization.

The following are precautions and procedure that must be followed to get best results from quenching treatments:

First, it is necessary to start with good close grained metal, reasonably low in carbon and silicon content. There are cases where the addition of the so-called carbide forming elements, such as chromium and molybdenum is advantageous. They tend to prevent possibility of excessive graphitization during the heating and quenching cycle. Too, they and nickel are said to lower the critical quenching speed, which is a distinct advantage in cast irons as well as in steels.

As a rule the strength and particularly the toughness of gray cast iron is impaired by quenching. The original strength and toughness is regained or exceeded by proper drawing or tempering. Drawing above 350 degrees Fahr. decreases the hardness and increases the strength and toughness. These latter usually are fully regained by drawing at 500 degrees to 600 degrees and commonly are considerably increased by drawing up to as high as 1000 degrees. The increases in strength and shock resistance may be as high as 50 per cent.

The hardness is greatest in the as quenched condition and becomes progressively lower as drawing temperature is increased beyond about 350 or 400 degrees. Hardness is not fully lost until draws are quite high. For example, an iron 2.70 carbon, about 200 brinell in the as cast condition approaches 500 brinell when quenched in oil from 1500 degrees and when drawn to 1050 for 2 hours still retains about 275 brinell.

The usual range of hardness obtained by treatment of machinable castings is 400 to 500 brinell. Properly quenched and drawn cast iron has an extremely fine almost silky grain, which is much lighter in color than the fracture of regular gray iron. It has excellent wear resistance, both in metal to metal wear and under mildly abrasive conditions. It is interesting to note that *heat treated* cast irons retain the resistance to galling and siezing characteristic of regular gray irons.

Nitriding, sometimes called ammonia hardening has been applied successfully to special cast irons. The process consists of heating for 2½ to 4 days at 900 to 1000 degrees in an atmosphere of anhydrous ammonia. The type of cast iron commonly used contains about 1.5 per cent chromium and 1.5 per cent aluminum, and is of low total carbon content, say 2.50 per cent to 2.75 per cent. It is claimed that if vanadium is added the aluminum can be dispensed with. Cast irons of this chromium and carbon content are quite likely to air harden. The usual practice is to anneal before machining. The castings then are hardened, drawn and nitrided.

Surface hardness equivalent of 800 to over 900 brinell is claimed, and it is reported that the case is reasonably tough.

Interest Widens

THIS discussion by Mr. Bolton, covering some of the fundamentals of the structural metallurgy of gray cast irons and the principles involved in its heat treatment, is particularly timely, due to the constantly increasing interest in that subject among foundrymen and engineers. Numerous foundries throughout the country now are applying heat treatment practices on regular production schedules and others are looking to that development as a means of securing certain desirable properties to their products. This article is from a paper presented at a meeting of the Cincinnati chapter of the American Society for Steel Treating.

Malleable Club Hears Several Talks

Four speakers featured the program of the regular meeting of the Malleable club, Milwaukee, on Feb. 14 at the Blatz hotel, with Prof. Scott McKay, department of metallurgy, University of Wisconsin, Madison, Wis., presiding.

S. Kitto, treasurer, Belle City Malleable Iron Co., Racine, Wis., discussed methods of figuring shop costs on the basis of estimates made from blueprints. He touched upon the influence of the estimated scrap losses and on standard costs.

R. O. Flansburg, assistant research engineer, Belle City Malleable Iron Co., presented the technical news report in which attention was called to articles in the technical press relating to problems of malleable iron production. This report stimulated a discussion on the effect of fine and coarse grinding of powdered coal on the cost of fuel and the ability to control the analysis of the iron.

T. Earl Paulson, Belle City Malleable Iron Co., led the discussion on estimates made by members of the club from the blueprint furnished by the Belle City Malleable Co. I. B. Dearsley, Walker Mfg. Co., Racine, Wis., previously had referred to the use of the planimeter and at this meeting demonstrated its use in connection with estimating the volume and weight of castings from blueprints.

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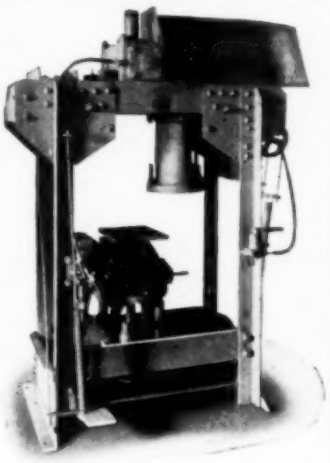

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European Foundry Practice

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Examines Chaplets

The Behavior of Various Types of Chaplets in Cast Steel and Gray Iron (Das Verhalten verschiedenartiger Kern-stuetzen in Stahl-und Grauguss), by H. Nipper, *Die Giesserei*, Dusseldorf, Germany, Dec. 23, 1932.

Five different types of soft steel chaplets were cast into steel and gray iron plates 0.4, 1.2 and 2 inches thick. Some of the chaplets were coated with tin, others were uncoated but cleaned with a sandblast, and some had an oxide coating obtained by heating for a few minutes at 1300 degrees Fahr. It was found that with cast steel the welding zone between metal and chaplet reached 80 per cent of the tensile strength of the comparison specimen with tinned and untinned chaplets. In gray iron the zone reached 80 per cent with tinned and 50 per cent with untinned chaplets. With oxidized chaplets the strength was only 16 to 26 per cent of the strength of the comparison piece.

Welding in Iron

The Repair of Defective Iron Castings, (La Reparation des Pieces en Fonderie de Fonte) by Francis Simore. *La Revue de Fonderie Moderne*, Paris, Nov. 10, 1932.

An iron casting can be repaired by iron welding when expansion and shrinkage can take place normally without risk of rupture. During the period of heating, means must be taken to ensure that expansion will be uniform: therefore, massive parts must be cooled down, and thin sections must be specially heated. An example is given in the description of a repair effected on a roll for a mixer.

Study Castability

The Castability of Cast Irons (La Coulabilite des Fontes). Report by Rene Berger. *La Fonderie Belge*, Liege, October, 1932.

In a previous report, published in August, the author described a method of testing castability with a precision of about 1 per cent. The present report deals with tests made on cast iron obtained in certain foundries and pig iron coming from certain blast-furnaces.

In addition to temperature and chemical composition, which are the only factors which can be measured with precision, there are other factors, such as control of the furnace, composition and nature of charges, etc., which affect castability. Further investigations will be made on synthetic alloys made in crucibles in order to secure a more precise definition of the laws governing castability.

Balanced Blast Cupola

Some Experiences with the Balanced Blast Cupola, by H. H. Shepherd, the *Foundry Trade Journal*, London, December 29, 1932.

This paper includes a report on experiences in operating two balanced-blast cupolas, one in malleable foundry and the other in a gray iron foundry.

The first section includes a description of the cupola. The tuyere arrangement consists of a lower row of main tuyeres and valves and two or more rows of small auxiliary tuyeres. The latter are situated in front and fed from the same wind belt. The most important feature of the main tuyeres is that they are controlled by fine adjustable screw valves, which enables the size of the blast inlet of the tuyere to be altered to suit requirements. The hand wheels are attached to a cylinder which can be moved in a horizontal direction and so vary the size of the ports or valve openings.

The tuyere apertures between valves and cupola linings are designed so that, although the air passing through the valves is at high velocity, the impinging effect on the coke is reduced so as to produce a softer blast. The valve stem is hollow to permit inspection and allow for temperature maintenance, gas analysis, etc. Each tuyere is fitted with an inspection glass and by an ingenious device it is possible to close up the tuyere and still observe melting conditions through the inspection glass. Loose outer covers also are fitted to permit cleaning tuyeres and valve ports.

Auxiliary tuyeres also are adjustable, the principle being somewhat similar to the main tuyeres, except that they do not carry screw valves. The adjustment is made by movement of an inner sleeve with a port and once the correct position is obtained the sleeve is kept in position by a set screw. The whole of the arrangement permits maximum elasticity of operation and close control.

The second section, in the Jan. 5 issue, discusses blast pressure, the cost of converting in the gray iron cupola, operation of the cupola, and similar information for the balanced blast unit.

Refining Iron

A Phase of Recent Research in Foundry Technique, by N. L. Evans, *Foundry Trade Journal*, Dec. 1, 1932.

This article relates some observations on the use of soda ash in the foundry. The author points out that soda ash rapidly is establishing itself in England as one of the cheapest means of improving quality of cast iron and helping to meet the modern demand. First used simply as a desulphurizing agent, it has been found subsequently to have a marked refining and degasifying action on the metal. It helps in the production of foundry castings, which also can be dealt with more easily in the machine shop.

The paper goes on to show that the effect of the use of soda ash on the economic side of foundry work cannot be neglected in the face of present day competition.

Some of the branches of the iron industry in England in which the soda ash process already has gained a firm footing are: The manufacture of refined pig iron and alloy pig iron: heavy cast iron castings, particularly those used in chemical plants; converter steel castings; malleable castings; and motor cylinder and other high grade castings which are required to withstand pressure.

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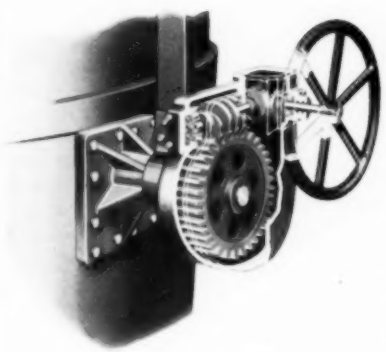

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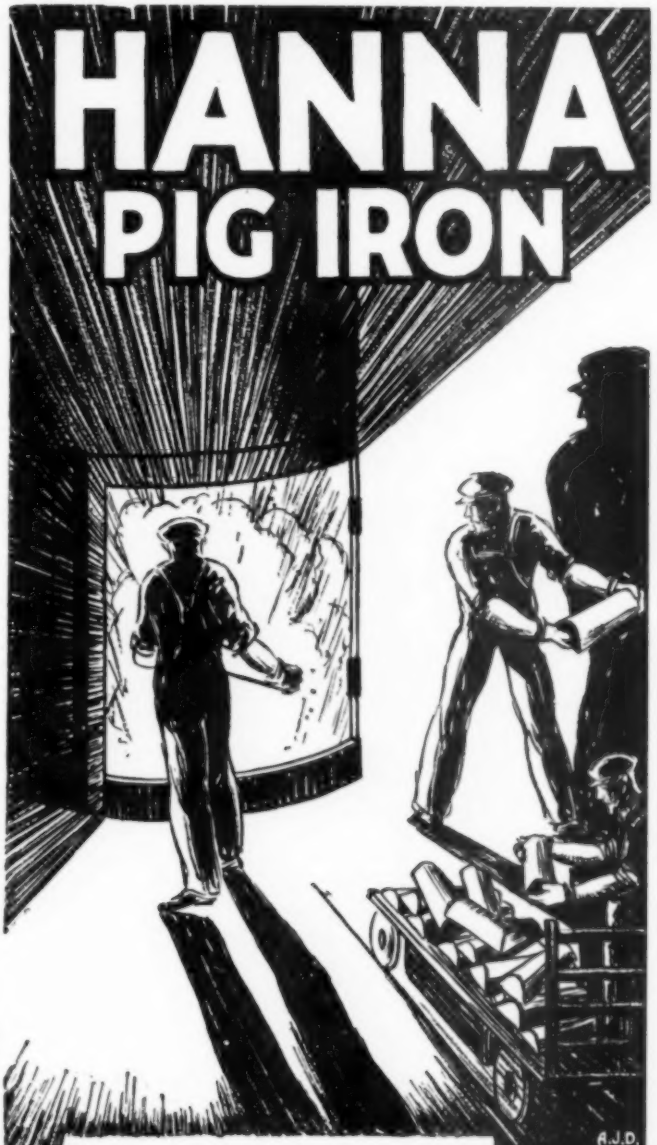

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Obituary

CHARLES C. RANSDELL, 63, former president, Gilbert & Barker Mfg. Co., Springfield, Mass., died recently. Mr. Ransdell resigned from the presidency of the company Nov. 1, 1932 after 40 years connection with the organization, to become western Massachusetts regional manager of the state campaign in share-the-work movement. He was a native of New Haven, Conn., and a graduate of the Sheffield Scientific school, Yale university, in 1892.

Charles V. Barrington, vice president, Jenkins Valve Co., Bridgeport, Conn., died recently at his home. Mr. Barrington was 71 years of age.

Willard R. Carroll, 61, a consulting engineer of the Farrel-Birmingham Co., Ansonia, Conn., died at New Haven, Conn., Feb. 3.

John P. Kolla, 72, one of the founders of the Holland Furnace Co., Holland, Mich., died recently. He was vice president and general manager of that company.

Jacob H. Albig, founder of the Mono-Yough Foundry & Machine Co., McKeesport, Pa., about 35 years ago and which he operated until 1926, died at Pittsburgh, Feb. 26.

Charles Edward Patterson, former vice president, General Electric Co., and president, General Electric Supply Corp., who retired from active business a few years ago, died at St. Petersburg, Fla., Feb. 12 after an illness of several months.

John J. Flatz, 74, founder and president, National Foundry Co., Milwaukee, died Feb. 1. Mr. Flatz was born in Mt. Calvary, Wis., and went to Milwaukee as a boy. After a number of years with the Allis-Chalmers Co., he established his own shop in 1907.

George J. Allmendinger, 58, president, Buckeye Brass & Mfg. Co., Cleveland, died Feb. 14 after an illness of several months. Mr. Allmendinger was born in Germany and came to the United States at the age of 13. He learned the patternmakers' trade and later developed the company of which he was president.

Charles C. Shepard, 74, for many years identified with the iron and steel industry, died recently at Omaha, after an illness of several months. Mr. Shepard was a native of Kendall county, Ill., and became general manager of the Buda Foundry & Mfg. Co., in Buda, Ill. The company later was moved to Harvey.

Frederick W. Reidenbach, formerly of Coates-Bennett and Reidenbach, Rochester, N. Y., died Feb. 24. Mr. Reidenbach was conected with Clum & Atkinson foundry, Rochester, N. Y., for a number of years and then was with the Genesee Metal Co. and later Coates-Bennett and Reidenbach. Approximately 40 years ago he pioneered the use of phosphor tin.

John M. Craig died at his home in Hartford, Conn. recently. Mr. Craig was born in Quincy, Mass., in 1860 and in 1892 went to Hartford where he became manager of the brass foundry of the Colt's Patent Fire Arms Mfg. Co. In 1905 he established the J. M. Craig Foundry Co. and continued in that business until the time of his death.

A. W. Wagner, president, Wagner Malleable Iron Co., Decatur, Ill., died at his home in that city February 5, aged 58. Mr. Wagner was active as a stockholder of the Decatur Malleable Iron Co. from its organization in 1916 until he withdrew in 1922 to organize the Wagner firm with which he was continuously identified until his death.

William Taylor Andrews, president, Stamford Foundry Co., died at his home in Stamford, Conn., recently. Mr. Andrews was born in Darien on Feb. 18, 1861 and became connected with the Stamford Foundry Co. on Feb. 1, 1886. He was made president of that company on Oct. 2, 1926. In middle life Mr. Andrews was able to gratify a long-felt desire to study law and was graduated in 1911 from Yale Law school and admitted to the Connecticut bar the same year.

Book Review

Introduction to Technocracy, by Howard Scott and others, paper, 61 pages 5 x 8 inches, published by the John Day Co. and supplied by THE FOUNDRY, Cleveland, for 90 cents and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

Regardless of the individual convictions regarding the accuracy of Technocracy's data and reasoning, the brief statement of principles underlying the movement, by those identified during the past 12 years with the Continental Committee on Technocracy, should prove of interest. The book has the official stamp of the organization and is understood to represent the official position of Technocracy, both in regard to its research activities and their social implications.

The first section contains much of the material which appeared in the preliminary and unpublished report of Technocracy, with considerable new material added. The second section was written by Howard Scott, Technocracy's chief proponent. It is pointed out in the foreword that this section is to be regarded as basic to an understanding to the approach of Technocracy toward the problem of operating a continental area with modern technological equipment. A selected reading list concludes the text.

In concluding his brief on the subject, Scott states that Technocracy proposes no solution but merely introduces the problem which has been raised by the technological introduction of energy factors in a modern industrial social mechanism. This country possesses all the essential qualifications for such a mechanism, sufficient to assure the continuance of a high energy standard of livelihood for at least a thousand years.

Set Up Commercial X-Ray Inspection Service

Victoreen Instrument Co., 5806 Hough avenue, Cleveland, has added an X-ray division for industrial radiography. The company will radiograph castings, metal parts, welds, small assemblies, etc. for the entire metal and alloy fields. It is pointed out that the cost of this work has been computed on a basis making it comparable to commercial photography, thus opening a new channel for inspection and production control in the foundry.

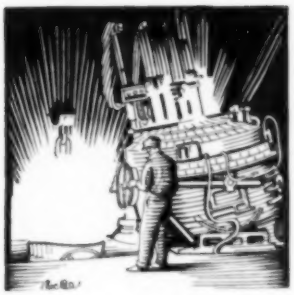
The Victoreen company has had eight years experience in X-ray science and has a staff of physicists and metallurgist to render assistance in problems in which radiography can be of service.

Record Life Work Of Engineering Leader

As a memorial to the life and death of Edward Orton Jr., former dean of its college of engineering, Ohio State university, Columbus, O., has published a 70-page book recording his activities as a man, a citizen, an engineer and an educator. Prof. Orton organized the department of ceramics in 1894, the first of its kind in the United States and was largely responsible for establishment of the engineering experiment station in 1913. He also founded the American Ceramic society in 1899. He served as dean of the engineering college from 1902-1906 and 1910-1915. His death occurred in 1932.

Howard F. Ramsey, associated with George F. Pettinos, Philadelphia, addressed the regular meeting of the Philadelphia Foundrymen's association at the Manufacturers & Bankers club, Philadelphia, on Feb. 8. Mr. Ramsey spoke on "Types of Steel and Semi-Steel Molding as Applies to Sand." Charles E. Schley, Philadelphia Bronze & Brass Corp., Philadelphia, presided.

New Equipment



For Foundries

Core Plates Are Made of Asbestos

A core plate made of specially compounded and treated asbestos in sheet form has been introduced in several foundries by Johns-Manville, 292 Madison avenue, New York. The material is supplied in sheets 36 x 48 inches and ¼, 5/16, ⅜ and ½ inches thick, or in rectangular cut pieces to meet the special needs of the foundry. Several features are claimed for the asbestos core plates, including lightness, which results in increased production. It is pointed out the plate does not rust, does not crack easily when dropped, does not warp under heat, has a slow rate of heat transmission, etc.

The hearth quality of the asbestos plate, which is said to be responsible for better baking characteristics, lies not only in its retention of the heat absorbed, but also in the uniformity of temperature maintained over the surface of the plate. This same quality has proved of considerable advantage in tray ovens for baking bread.

Lightness of the asbestos core plates is illustrated in Fig. 1 where the workman at the right is carrying 11 core plates weighing a total of only 115 pounds. Fig. 2 shows a rack of cores on asbestos core plates ready for the core baking oven.

It is pointed out that the same stock which is used for the core plates also may be used for making molders' benches, bottom boards and match plates.

Photographic Plate Useful in Metallography

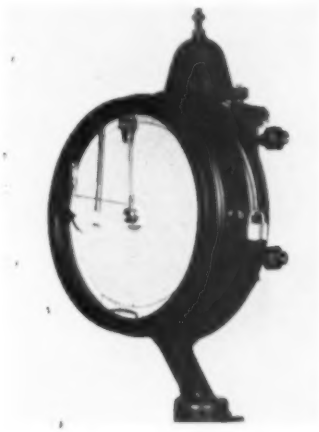
A new photographic plate designed especially for photomicrography of metal specimens has been developed by the Eastman Kodak Co., Rochester, N. Y. The plate employs a new photographic sensitizing dye recently developed by that company.

The characteristics of the new plate which renders it especially useful in metallography are as follows: High resolving power, permitting the best reproduction of fine details; availability of a high photographic contrast, for such subjects as steels at high magnification; availability of lower contrasts, yielding good negatives where there is high contrast in the image, as with steels of low magnification, cast irons, etc.; high green sensitivity as well as high sensitivity to blue light, which gives the plate maximum usefulness when used either with acromatic objectives and green filters, or with apochromats; an absence of sensitivity to red light, with the resulting freedom in dark room handling.

Fig. 1 (Left)—The workman is carrying 11 plates weighing 115 pounds. Fig. 2 (Right)—Cores on plates ready for the oven

Pressure Recorder Measures Flow of Gas

Foxboro Co., Foxboro, Mass., has developed a new bell type differential pressure recorder for use as the measuring unit in the air weight controllers used on fan or centrifugal blowers. The air weight controller



The bell type differential pressure recorder is used with air weight controllers

was described in the November, 1932 issue of THE FOUNDRY. The recorder when used with an orifice plate, venturi tube, flow nozzle or pitot tube becomes an inferential type meter. The new recorder was designed especially to give accurate measurement of the flow of gas or air at low pressures.

In the operation of the air weight controller, accurate measurement of the air flow is the first essential of accurate control. Where air is being delivered to a cupola at a low pressure, the pressure recorder and the air weight controller provide constant, automatic delivery of the desired amount of air to the cupola. It is claimed that with control of the air weight assured, the cupola operator can cut the coke charges and air by gradual steps until the ratio of iron to coke is as high as possible with the equipment available. A view of the new type recorder is shown in the accompanying illustration.

Underfeed Screw Stoker Is Automatic

Link-Belt Co., 2410 West Eighteenth street, Chicago, has developed a new automatic underfeed screw stoker which is made in a number of sizes suitable for heating plants and smaller steam plants, using boiler capacities from 10 to 250 boiler horsepower.

The stoker, which is shown in the accompanying illustration, has a specially designed motor mounting, permitting direct connection to the forced draft fan, and providing easily accessible and compact assembly. Variable speed transmission regulates the coal feed. A clean out door may be removed easily and the transmission may be removed for access to the feed screw without disturbing the motor and fan mounting. The coal feed tube, the bedplate and the long narrow retort are finished castings of heavy gray iron. The unit is provided with automatic electric control for operating at predetermined boiler pressures. A safety shearing pin provides overloading protection.

Many parts of the stoker are gray iron castings

Dust System Is Cleaned Mechanically

Allington & Curtis Mfg. Co., 1500 Holland avenue, Saginaw, Mich., has developed a dust collecting system with a self clearing main mechanically operated. The main may be straight or of the circuit type and is applicable for foundries, both for grinding operations and for tumbling mills, and for sandblast rooms. The equipment also is especially adapted to pattern shops and other woodworking establishments.

In the circuit type unit, a comparatively large endless duct takes the place of the main suction conveyor pipe. Branch pipes from machines are tapped into the main anywhere around the circuit. At least one fan is attached to the circuit which blows into a collector. This fan creates a partial vacuum in the endless main, and air and materials are drawn from the machine, through the branch pipe, into the main, as in any exhaust system.

Dust in the circuit main is moved with mechanical flight conveyors inside of the main. The conveyor is slow moving, traveling 30 feet a minute or less, thus providing an exceedingly small amount of wear on the pipe. The system cannot become clogged because the conveying is mechanical and positive. It is pointed out that the system is flexible to suit any possible changes in machine locations and will take care of additional machines without the necessity of rebuilding the mains.

Grinder Is Portable

Black & Decker Mfg. Co., Towson, Md., has introduced a new 6-inch electric bench grinder designed for all types of bench grinding, tool sharpening, etc. The unit is portable and has a convenient carrying handle. Balanced rotating parts are included to minimize vibration, while rubber feet are used to decrease noise. The unit is supplied with two grinding wheels, one coarse and one fine, with ½-inch faces. In addition, two adjustable tool rests and two adjustable wheel guards are provided, the latter making it possible to grind at any position on the circumference of the wheel. The unit is equipped with bronze sleeve bearings.

Circuit Protection

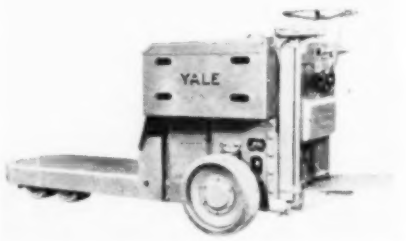
General Electric Co., Schenectady, N. Y., has introduced a new line of manually and electrically operated, trip-free multipole air circuit breakers for the control and protection of circuits in all fields. The breakers are obtainable in metal enclosed construction, with or without pull box, metal enclosed with pull box and disconnecting devices to permit inspection of the breaker while it is disconnected from the source, or mounted in dead-front and metal enclosed switchboards which are shipped assembled from the factory. The ratings range from 15 to 400 amperes, 250 volts direct current and 600 volts alternating current.

Industrial non-fatal injuries number about 1,500,000 annually and together with the deaths, cost about $6,000,000,000 each year in wages, medical expense and insurance.

Lift Truck Has Capacity of Five Tons

Yale & Towne Mfg. Co., Philadelphia, recently introduced a new model low lift truck with a rated capacity of 10,000 pounds. The truck has six wheels, four 10½ inches in diameter by 6 inches wide directly under the load platform in addition to the two 20-inch diameter by 6-inch wide driving wheels under the battery compartment. All six wheels steer by hand wheel with suitable reduction providing easy steering under all load conditions. Either vertical or horizontal steering wheel is optional.

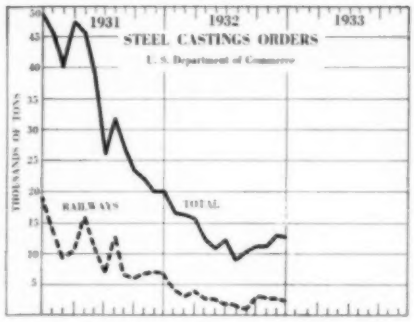
The tandem rear wheel trailing axle, directly under the load platform, is hinged to the main frame members in such a way that a fore and aft compensating or rocking movement is possible, providing equal load distribution when the truck is running over obstructions or grades. The load platform is 11 inches high in the low position with a 6-inch platform lift giving a height of 17 inches when fully elevated. The platform lift giving a height of 17 duction spur gear power unit through sprockets and roller chains. An automatic cut-off switch limits the platform travel in either direction.

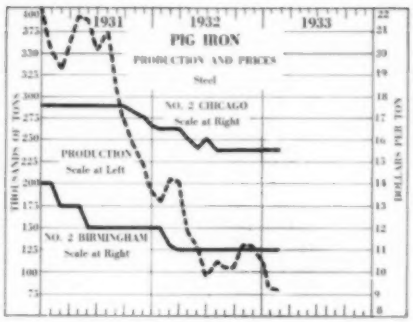


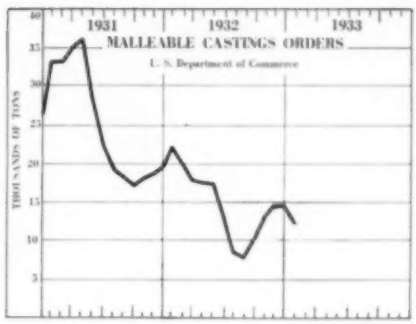
The platform is 11 inches high at the low position

Standard equipment on the truck includes the heavy duty driving unit with a large series wound motor. The service brake, with large area, rigid brake shoes, is mounted directly on the motor end head opposite the driving pinion so that braking effort is distributed through the differential equally on both driving wheels. The truck has a safety inter-locking controller which is so arranged that the controller must always be returned to the neutral position and the brake released to obtain traveling power. The controller has four speeds forward and four reverse, giving smooth easy starting without jerking the truck.

General office of the Association Technique de Fonderie has been moved to 44, Rue de Rennes, Paris (6), France.







Foundry Activities

Reflect Industrial Trends

SUPERIOR BRASS & ALUMINUM FOUNDRY, Columbus, O., recently formed, has leased part of the former plant of the Iron Products Co., 417 West Spring street, for production of brass and aluminum castings. J. W. Hayes is president and N. A. Neal secretary and treasurer, both having been associated with the Iron Products Co.

* * *

The new foundry, recently organized at Orrville, O., has started operations in the old plant of the Quality Castings Co.

* * *

E. W. Bliss Co., has received an order for a rolling mill to cost $500,000. The equipment will be built at the Salem, O. plant.

* * *

Delta Steel Foundry, Tallulah, La., has been incorporated wih $5000 capital to operate a foundry and produce castings.

* * *

Sleyer Steel Casting Co., Milwaukee, recently completed installation of a new four ton electric melting furnace, replacing a unit which has been in service 15 years.

* * *

Nekoosa Foundry & Machine Works Inc., Nekoosa, Wis., has been incorporated with $25,000 capital, by James C. Dutton, attorney, Nekoosa State Bank building, Nekoosa, Wis.

* * *

City council has granted a permit for erection of a new pipe foundry by the Emory Pipe & Foundry Co., Anniston, Ala., to cost about $75,000. W. C. Wilson is president.

* * *

Westmoreland Malleable Iron Co., Ltd., Westmoreland, N. Y., is observing its 100th anniversary. The business was founded at Oak Hill in Greene county by Calvin Adams. The concern was first known as Smith, Buell & Co., afterward Smith Halleck & Co., later it was called Smith, Clark & Co., then Clark, Metcalf & Co. and in 1877 the present name was adopted.

* * *

Farrel-Birmingham Co., Ansonia, Conn., recently elected the following officers: Franklin Farrel Jr., chairman of the board, Nelson W. Pickering, president, David R. Bowen, vice president, Carl Hitchcock, vice president, Franklin R. Hoadley, vice president, Armin G. Kessler, vice president, Frederick M. Drew Jr., treasurer, Laurie K. Blackman, assistant treasurer, George C. Bryant, secretary, William B. Marvin, assistant secretary.

* * *

Hugh Martin, president Detroit Gray Iron Foundry Co., has reported that production of vanadium iron in 1932 was the greatest since its introduction by that company six years ago.

* * *

Ambler Furnace & Foundry Co., Northville, Mich., has been sold by S. W. Ambler to Henry Chambers, Detroit, and the name will be changed to Independent Furnace Foundry Works. The plant produces castings and furnaces.

* * *

James Spence Iron Foundry Inc., Jersey City, N. J., has been incorporated with $100,000 capital to operate an iron foundry, by Irwin & Davidson, attorneys, 99 Lembeck avenue, Jersey City, N. J.

* * *

Franklin Die Casting Co., 2535 Greenview avenue, Chicago, has been incorporated with $40,000 capital to conduct a commercial die casting business, by Isadore Kaplan, 11 South LaSalle street, Chicago.

* * *

Canadian Ohio Brass Co., Niagara Falls, Ont., subsidiary of the Ohio Brass Co., Mansfield, O., has sold its manufacturing site here and will build a new modern plant on other property using the present plant until completion of the new.

RAW MATERIAL PRICES
March 7, 1933

Iron	
No. 2 foundry, Valley	$14.50
No. 2 Southern, Birmingham	11.00
No. 2 foundry, Chicago	15.50
No. 2 foundry, Buffalo	16.00
Basic, Buffalo	15.50 to 16.00
Basic, Valley	14.00
Malleable, Chicago	15.50
Malleable, Buffalo	16.50
Coke	
Connellsville beehive coke	$2.50 to 4.00
Wise county beehive coke	3.00 to 4.25
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$8.50 to 9.00
Heavy melting steel, Pitts	8.00 to 8.50
Heavy melting steel, Chicago	5.00 to 5.50
Stove plate, Buffalo	7.00 to 7.25
Stove plate, Chicago	4.50 to 5.00
No. 1 cast, New York	4.50 to 5.00
No. 1 cast, Chicago	5.75 to 6.25
No. 1 cast, Pittsburgh	9.00 to 9.50
No. 1 cast, Philadelphia	9.00 to 9.50
No. 1 cast, Birmingham	9.00 to 9.50
Car wheels, iron, Pittsburgh	7.75 to 8.25
Car wheels, iron, Chicago	8.00 to 8.50
Railroad malleable, Chicago	6.00 to 6.50
Agricultural mal., Chicago	5.00 to 5.50
Malleable, Buffalo	8.00 to 8.50
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	4.75
Straits tin	23.75
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt Cleveland	8.00 to 9.00
Lead, New York	3.00
Antimony, New York	5.75
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	2.75

New Trade Publications

PATTERN SUPPLIES—Kindt-Collins Co., 12697 Elmwood avenue, Cleveland, recently has published an 81-page catalog illustrating and describing its complete line of supplies for the pattern shop. In addition to the catalog features, information is presented on pattern practice, process of making plaster casts in its various stages, standard color markings for patterns and core boxes, and technical information on melting and pouring aluminum.

DIE CASTINGS—The Chicago Die Casting Mfg. Co., 2512-14 W. Monroe street, Chicago, has published special stock bulletin No. 28 listing its line of die cast pulleys, couplings, bearings, etc.

WELDING ALUMINUM—A 42-page booklet on the welding of aluminum has been issued by the Aluminum Co. of America, Pittsburgh. The booklet describes the various operations in welding and illustrates welding rods.

CENTRIFUGAL PUMPS — Single stage centrifugal pumping units are described and illustrated in bulletin No. 218 recently issued by the Pennsylvania Pump & Compressor Co., Easton, Pa.

ROLLER HEARTH FURNACES—W. S. Rockwell Co., 50 Church street, New York, has published bulletin No. 335 describing electric and fuel fired roller hearth furnaces for continuous heat treatment of metals. Various features of the equipment are described.

TESTING SIEVES—Newark Wire Cloth Co., 351-365 Verona avenue, Newark, N. J., has issued a folder describing its testing sieve shaker and its line of cornerless testing sieves. The folder contains considerable descriptive matter, tables, etc.

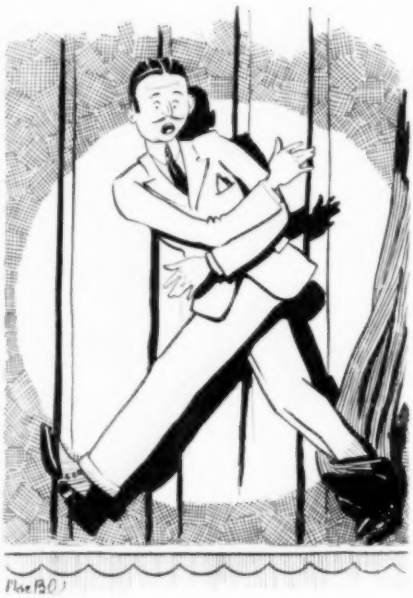
WELDING — Harnischfeger Corp., Milwaukee, has issued catalog No. HW-2 entitled "Weld It Well." The catalog illustrates and describes the line of arc welding equipment manufactured by that company, illustrates a dozen points of distinction of the welders, and shows the cross section of an arc welding unit.

BENTONITE — American Colloid Co., Transportation building, Chicago, has published several information circulars on steel foundry facings for green sand molds, discussing simple basic principles of good facing, directions for facing, and various other recommendations on to those subjects.

ALLOY CAST IRON—Electro Metallurgical Co., Carbide & Carbon building, 30 East 42nd street, New York, has published a bulletin on "Properties and Advantages of High Chromium Cast Iron." Information is given on composition, methods of melting, fluidity, physical properties, growth, scaling, corrosion, and cost.

METAL ABRASIVES — Steelblast Abrasives Co., 6538 Carnegie avenue, Cleveland, has issued a bulletin showing reproductions of photographs of various sizes of shot and grit, for blasting. Information also is presented on the care of the blasting room and an air and abrasive table based on 80 pound air pressure is presented.

Faked Foundry Facts



A Tumbling Star

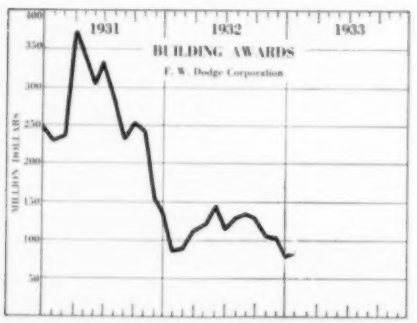
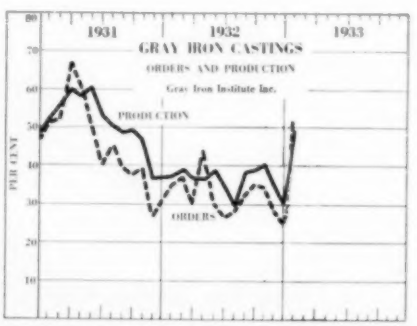
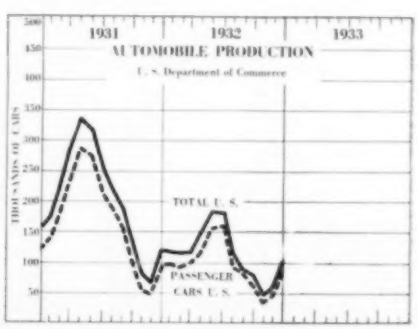
HEATING UNITS—A bulletin No. CA-106 recently published by Edwin L. Wiegand Co., Pittsburgh, describes electric heating units of the immersion type, space heaters, electric ring units, etc. Reproduction of photographs show the application of various heating units to numerous industrial operations.

COMPRESSORS — Single-stage, centrifugal compressors ranging from 5 to 30 horsepower are described in bulletin GEA-1344A recently published by the General Electric Co., Schenectady, N. Y. The blower is recommended for a variety of uses including annealing furnaces, brass melting furnaces, cupolas, conveyiny pulverized coal, sandblastings and ventilating.

MECHANICAL RUBBER GOODS—A bulletin recently published by the B. F. Goodrich Rubber Co., Akron, O., describes a soft elastic rubber, black in color, used as a protection to other surfaces from abrasion of wet or dry materials. It is pointed out that the rubber can be attached to any surface with mastic tar, melted and spread on the surface and the rubber applied before the tar is cool.

SPECTROSCOPE — Adam Hilger Ltd., 98 Kings road, Camden road, London, N. W. 1, has published a pamphlet on "Increasing the Quantitative Accuracy of a Spectroscope." This is accomplished through a simple eyepiece attachment, so designed that a spectrum line of a minor element present in a substance can be compared in intensity accurately with a neighboring line of a principal element in the substance.

WELDING RODS—A booklet published by the Linde Air Products Co., New York, describes the physical and welding characteristics of a new bronze welding rod. It is claimed that this rod makes it possible to obtain tensile strengths in joining steel between 56,000 and 60,000 pounds per square inch and ductility in excess of 30 per cent. The booklet describes many important applications and includes recommendations for bronze welding.

COST SYSTEM—Edwin S. Carman Inc., Lee road at Mayfield, Cleveland, has published a folder on a combination, condensed cost and audit system for the executive control of costs. The text indicates the development of the idea, the need for such a system, the information which is shown by the master card, and the result of the system. The study of the cost should permit a decrease in expenditures by the elimination of waste in materials, supplies, labor, both productive and non-productive, including all overhead and other fixed charges.

SAFETY CONFERENCES — Policyholders Service bureau, Metropolitan Life Insurance Co., New York, has prepared a new publication "Foremen's Safety Conferences," which presents one method being used rather extensively to develop safety interests among foremen and others in supervisory positions. The report offers suggested programs for a series of seven informal conferences to discuss the various phases of safety work, the meetings being presided over by some representative of the management. The programs were developed following a review of activities of a number of industrial organizations in the United States.